E/CONF.39/D/183
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.1

United States of America

# THE STRATEGY OF INDUSTRIAL DEVELOPMENT

By William A.W. KREBS,
Vice President,
Arthur D. Little, Inc.,
Cambridge, Massachusetts,
U.S.A.

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# THE STRATEGY OF INDUSTRIAL DEVELOPMENT

by
William A. W. Krebs, Vice President
Arthur D. Little, Inc., Cambridge, Massachusetts, U. S. A.

## INTRODUCTION

1. In the perspective of history the belief that man can remake his economic environment to the image that he desires is a new idea. That he can do so without sacrificing the political freedom of individual citizens is controversial. Combining these notions in a program of action is an act of faith and daring. The remarkable fact is that so many of the nations of the world have embarked on such an adventurous course in this generation.

2. The battle for economic development thus joined is fought on many fronts of which the industrial is only one and, in most nations at this stage of the battle, statistically the least significant. In this decade the greatest advance in per capita income in most of the developing nations will arise from increasing the productivity of agriculture. The symbolic importance of industry is so great, however, that progress in industry is a political necessity in the development battle, quite apart from the important role that the processing and supply industries play in supporting the growth of agriculture everywhere and the promise of rapid industrial advance on a broad front in certain countries.

3. Industrial development, in appropriate balance with other development effort, is thus indispensable, and a strategy especially designed for the industrial sector must be a part of each country's larger strategy of economic development. The design of such a strategy however must remain for many years to come more art than science. Industrial-development programs in enterprise economies outside the continental United States or Western Europe are of recent origin, with the notable exception of Puerto Rico whose 20 years of intensive industrial development provide a rich store of experience. Facts about such programs are inadequately available; analysis of their meaning has scarcely begun. Twenty years from today, one may hope a social science of industrial development may have emerged. For the present, we must work with much less - but work we must.

4. Fortunately it is possible to distill from even such limited experience a body of principles which may be regarded as the elements of a strategy for industrial development having general applicability to the needs of the less-developed areas of the world. These elements may be classified as institutional, procedural and substantive.

## INSTITUTIONAL ELEMENTS OF AN INDUSTRIAL DEVELOPMENT STRATEGY

5. The key institutional element in successful industrial development strategy is a central executive organization having high professional competence and political power. In some underdeveloped countries such an institution already exists; in others, its functions are present but are being exercised in a variety of political and economic organizations scattered through the governmental structure of the

private economy. Successful programming requires that these functions be centralized, placed in competent hands, and backed to the hilt with political power.

6. The mere establishment of such an institution - whether it is called an Industrial Development Corporation, an Industrial Development Center, or by some other name - has symbolic importance inside and outside its country. It demonstrates that the country is serious about industrial development. It shows that the acceleration of industrial development is recognized as something that is not expected to happen without major, concentrated effort, that it is seen as a key task which ministries which have their normal work to do cannot be expected to perform adequately, and something which a few key individuals, no matter how highly placed, cannot do without adequate budget, technical staff, and capacity to follow through.

7. The role of the industrial development organization is primarily to give leadership in mobilizing the resources of the country for industrial development. This means working closely with both government agencies and representatives of the private sector. It also means making full use of the increasingly wide range of resources available from outside the country from international agencies, from foreign governments, from foreign industries and investment organizations. Another major task is to act as the government's advisor on a wide variety of important policy questions affecting industrial development, including taxation, tariffs, labor laws, education and financial policy. The organization must monitor the economic climate from the point of view of industrial development to identify the barriers which are holding development back and to take action to see that something is done about them. Many such barriers can be broken but often only after months or years of study, of steady and intelligently applied pressure, and long campaigns. The organization should also be the center for information of interest to potential investors in industry, both foreign and local. This involves maintaining adequate statistics and library reference material and carrying on research to obtain information not readily available. Publication of basic information of interest to prospective investors is usually also necessary.

8. The conditions which are essential to the success of the key executive organization for industrial development include continuity of basic personnel and policy, strong leadership, highly qualified staff, full support of the key ministries, and the respect of the private sector. Continuity can often best be achieved by establishing such an organization at a position midway between government and the private economy, with a mixed government-private board or governing body. It can then better survive the changing tides of political fortune while remaining responsive to the changes of policy which must come with changes in government.

9. Strong leadership requires that the head of the organization be a person who commands the respect of the ministries of the government, of the bankers and industrialists, of foreign businessmen and government officials, and - in many countries - of labor leaders and the press. This is a large order in any country, but failure to meet it is likely to lead to failure of the program.

10. Backing such an individual with highly qualified staff is equally essential and perhaps even more difficult in view of the shortage of such persons in most developing economies. Fortunately, if the policies of the country will permit it, the use of expatriate specialists, either as individuals or through contract with the increasingly large number of foreign organizations - both public and private - which now operate in this field can fill the gap while nationals are being trained to execute the duties of staff.

11. Full support of the key ministries is important because industrial development depends so heavily on preconditions and services which are the responsibility of government almost everywhere in the world. For example, the design of highway systems can have a stimulating or stultifying effect on regional dispersion of

industry; decisions on tariff policy spell for many industrial projects the difference between survival or failure; labor laws vitally affect competitive position.

12. The same conditions which lead to continuity and strong leadership are likely to earn for the organization the other essential ingredient for its success the respect of the private sector of the economy, without which, in the mixed economy characteristic of so much of the developing world, little can be done. Winning the confidence of those with the private investment resources and managerial skills necessary for industrial development, like winning the confidence of the ministries, is an essential prerequisite for success of the executive organization in building strong industrial development programs.

13. Around or within the key executive organization for industrial development must be clustered a range of ancillary specialized institutions. Like the concept of the central organization itself, the ideas expressed in many of these have emerged only recently. As tools of industrial development, they are still experimental and evolving. They include development banks, technical assistance institutes, industrial development consulting centers, and managed industrial districts. Each of them has a unique contribution to make to a program of industrial development. If institutions of these kinds do not exist in a developing economy, one of the first tasks of the central industrial development organization is likely to be to create them or bring about their creation.

14. The development bank in one form or another, normally a quasi-governmental corporation charged with responsibility for mobilizing capital for economic development programs, is by now a common phenomenon in the developing economies. The number of such institutions around the world today numbers close to a hundred and more are appearing as new programs of development are launched. Historical studies have shown that such institutions in various forms, normally operating as private investment banks, have been an essential component of economic development in Western Europe and the United States since the beginning of the industrial revolution. The basic difference between a development bank and a commercial bank is that, while the latter engages in financing trade and commerce through loans usually limited to one year, a development bank provides medium and long term "soft" loans and, more importantly, invests in equity securities of new enterprises. This is normally the least easily available form of capital in a developing economy. Of almost equal importance in contributing to the success of new industrial projects is the practice of the better-run development banks of making careful technical and financial analyses of new ventures as well as rendering consulting assistance to management during early stages of operations. Fortunately, there are relatively plentiful sources of capital for development banks today from international institutions, from the foreign assistance programs of the industrialized countries, and from the governments of developing countries themselves.

15. A further contribution that a well-managed development bank can make is to stimulate the creation of a capital market for securities of industrial enterprises, thus channeling local capital away from relatively unproductive uses into the mainstream of industrial development. If such a bank also participates actively in cooperation with the central executive organization for industrial development in searching out and analysing the merits of investible industrial projects, it can effectively catalyze the growth of industry. In economies where this kind of institution is not present, or where its effectiveness has been limited for any of a variety of reasons, early attention to strengthening it is an element of industrial development strategy that will pay dividends.

16. The technical assistance institute is another specialized institution for the support of industrial development which may have to be created or enlarged to accelerate industrial growth. Such an organization ideally will provide at least the following services at a high level of skill and a low level of cost relative to value: management counsel, product and process development, market research,

technical trouble-shooting, and applied research and development. In at least a portion of its program such an institute must be in a position to maintain proprietary confidences of its industrial clientele. It follows that, although it must almost always be subsidized by government in its early stages, it must be so organized as to give it substantial independence of government at the earliest practicable date.

17. Somewhat like the technical assistance institute, and overlapping it in function in the management field, is the industrial development consulting center. Of particular value in those economies with a thin layer of trained business management or with poorly developed small and medium scale enterprises, this institution - of which increasing numbers of prototypes have recently been appearing - concentrates its services on the business management problems of industrial enterprise, and extends in effect a subsidized management consulting service. In some forms this service has been coupled with provision of a wide range of training programs, both at the headquarters of the institution and on the job, and with an information service designed to bring to the attention of industrial managers the most useful and current knowledge of their professional field and the industry within which they function.

18. The planned and managed industrial district represents still another institutional device called into being by the special needs of industrial development programs. Experience with the industrial district - variously called industrial estate and industrial park - goes back to the 19th century in both the United Kingdom and the United States, in both of which it has been spectacularly successful. More recently Puerto Rico and India have experimented in the field with good results. Fundamentally, an industrial district is an area prepared with sites, roads, utilities, a communication network, service facilities, and in some cases shell buildings or even completed simple factories, ready for occupancy, with internally consistent legal and management arrangements specialized to meet the needs of industrial tenants or cooperative owners. Prearranged financing for equipment or even working capital is sometimes provided, together with advisory services, assistance in meshing into the community, and other amenities designed to ease the entrance onto the scene of foreign or new indigenous industrial enterprises. Economies of scale in planning and construction and the immense value of "readiness" are the significant advantages offered by this approach to expanding enterprise. Recently, the planned industrial district has been experimentally used in an effort to make national policies for decentralization and regionalization of industrial development more effective.

19. Another group of ancillary institutions must be of concern to the central executive organization responsible for industrial development - those necessary in the creation of the intellectual infrastructure of an industrial society: the vocational training schools, the centers for management education, and the universities which supply the leaders of the service professions of law, accounting and finance. Obviously the techniques for stimulating activity in this quarter must be more subtle, more indirect, and in some ways more imaginative than those applicable to other parts of the institutional problem. In the long term, however, the quality of these independent institutions will govern the quality of the development program. In many developing countries the pattern of education has been classical or oriented to the supply of civil servants rather than industrialists, engineers and businessmen. Redressing this imbalance, consistent with the limitations of the culture and the economy, requires long and costly effort, but it must be made. One technique which has proved effective is fostering linkages between indigenous centers of learning and foreign institutions prominent in technology, management education, and vocational training. In some countries, ambitious experiments are under way which include the creation of new institutions of learning which emphasize these aspects of education, sponsored by foreign institutions and sharing their faculties during the early years.

20. Each of the ancillary institutions described must be designed for the special circumstances of each national or regional setting into which it is to be fitted. Fortunately, however, experience with all of them is accumulating and in recent years the literature of experience is becoming more widely available. A successful strategy for industrial development will draw heavily on such experience while adapting it flexibly to local requirement.

## PROCEDURAL ELEMENTS OF AN INDUSTRIAL DEVELOPMENT STRATEGY

21. So far as experience may be relied upon as a guide, it suggests the importance of four procedural elements in a successful industrial development strategy:

(a) Early formulation and use of quantitative objectives.
(b) Adherence to a system of priorities for development.
(c) Reliance on sound economic research to illuminate decisions of policy.
(d) Energetic promotion of investment.

22. That finite goals are important means for mobilizing effort is a fact of human nature. An industrial development program requires a timetable and quantitative objectives. In the most successful programs these have been expressed in the number of industrial jobs to be added to the economy in some fixed period of time, in units of production of key commodities, in numbers of industrial establishments to be created, and in monetary wages. Experience suggests that the danger is greater of setting too modest a target than of unrealistically reaching beyond reasonable capacity. The most successful programs of industrialization have been dramatized in terms which caught the imagination and awakened the enthusiasm of the whole community and, often by contagion, of industrialists and investors in foreign countries.

23. Since industrial development is most effective when carried out in the context of a broad and comprehensive economic development plan for all sectors, sound strategy requires consistency between industrial plans and those for the other parts of the economy The recent emphasis on intermediate-range national economic planning for development in many countries is a welcome phenomenon and permits industrial development to be both more orderly and more realistic. Critics of planning who express concern that it leads to destruction of private initiative in economic affairs miss the point. On the contrary, a well-defined set of objectives and realistic procedures for moving toward them is evocative of the best efforts of the entrepreneur, as experience in Puerto Rico - certainly an enterprise economy - testifies.

24. Of nearly equal importance to quantitative objectives is adherence to a system of priorities in making the key decisions. Everything cannot be done at once with limited resources. An explicit framework of priorities for development, honestly constructed and consistently adhered to, will take the heat out of difficult decisions which will otherwise be made on grounds of political expediency, thoughtless enthusiasm or other unsound bases.

25. Both objectives and priorities can only arise - if they are to be sound - out of careful and conscientious economic and sometimes technical research. The time and money spent in obtaining a clear and complete view of the circumstances within which the development program is to proceed is the least costly investment that can be made even though it may require hundreds of thousands of dollars and months of painstaking effort. Nor is research something to be done once and filed away. The pace and complexity of change mean that every decision must be regarded as open to revision in the light of changed circumstances, so that a strong economic research staff must be continuously addressing itself to the production of new information and insights into the continuing process.

26. In danger of being overlooked but critically important for success is the use of investment promotion in industrial development. Fundamentally, promotion of

investment is required because of the imperfect knowledge about opportunity and risk which exists in even the most sophisticated investment community. In the case of a developing economy the imperfections are enormously greater. Promotion is the communications function which connects investor with opportunity and gives him the knowledge and the confidence to risk capital in industrial development. For most developing economies promotion of investment from abroad is the most critical task. Foreign investors usually have little knowledge of the developing country, its laws and its people. Accordingly they lack confidence in their ability to enter successfully, even if their attention has been attracted by general favorable publicity. A system must therefore be devised to overcome this lack of confidence and lead the desirable prospective investor virtually by the hand through the stages of early investigation to decision-making and later through startup and early stages of operations. The most highly successful investment promotion programs, like the most highly successful industrial development programs (and they have to date been largely the same ones), have been both massive and highly personalized, with great emphasis on research and the communication of accurate factual data to carefully selected prospects. A failure to budget adequate funds or plan sufficient effort for the promotional phases of development can waste all the other expensive gains of a fine industrial development program.

## SUBSTANTIVE ELEMENTS OF AN INDUSTRIAL DEVELOPMENT STRATEGY

27. The substantive elements of an industrial development strategy are the most diverse, specialized to each situation and controversial. Even here, however, experience has begun to yield lessons which validate principles of general applicability.

### The Importance of Market Analysis

28. It is likely that more waste has been caused in industrial development programs from decisions made with inadequate knowledge of the market for production than from any other single cause. This is a particularly common phenomenon where a substantial portion of the capital for the project comes from public agencies or from a large number of private investors no one of whom has actual experience in the operation of the particular industry. On the other hand, a careful examination of present and potential markets for the products of industry, and the selection of projects on this basis, can be the touchstone of success. Like so many other aspects of management "science", market research has developed methodology and principles which can best be applied by experienced professionals. At the same time, no specialist in marketing can possibly be sufficiently familiar with all sectors of industry and factors affecting markets for a wide range of products. Thus a successful program of market research requires both the marketing expert and the industry specialist. The selection for emphasis in an industrial development program of those industrial sectors in which market analysis indicates opportunity, not only for the present but through the foreseeable future, can be a key substantive element for success.

### A Policy of Integrated Development

29. The extent to which the selection of industrial projects to be emphasized in a development program can be guided through analysis of the degree to which they mutually support and stimulate one another is a controversial matter. It is clear, at least, that industrial projects can be linked to one another in the sense that one provides the raw material or the market for the other. There is a growing body of theory which suggests that certain types of industry tend to induce or stimulate complementary industrial activity to a higher degree than others Thus the much-maligned iron and steel industry is seen as having a high degree of interdependence with other sectors both in terms of purchases from them and sales to them while such activities as fishing, transport, services and trade have relatively low interdependence characteristics and therefore presumably low priority

in development programs, at least for that reason. Of course, the importance of such an activity as fishing for supply of protein in low-protein diets represents the kind of qualification for such a priority selection that illustrates its basic complexity. To the extent that analysis can carry the load, however, it appears important that attention be paid in formulating development strategy to the stimulus-creating aspects of new projects or, in other terms, how well they will "mesh into" the growing economy.

Application of the Test of National Benefit

30. The analysis of an industrial project to test the costs it will place upon the economy as well as the benefits it can be expected to produce is an essential but sometimes neglected step of industrial development programming. While in many cases an industrial project which is sufficiently promising to attract investment capital will without question represent a net gain to the national economy, there are also situations in which there may be a great difference between the value of a project to its private owners and its value to the economy as a whole. For example, because a project may use labor which is unemployed otherwise, it may be more valuable to the national economy than a simple tabulation of the wages to be paid, for purposes of private analysis of the soundness of the investment, would show. Similarly a project using natural resources which would otherwise be wasted, such as forest products, may have a greater value to the economy than to the private company which must pay for the resources at regular prices. A project which can make a valuable contribution through training labor or in providing services or goods needed by other new industries, thus serving as a stepping stone in the process of industrialization, may have a surplus of value to the economy that will not show up in the entrepreneur's calculation of commercial profitability.

31. The converse may also be true. A project to substitute local production for imports may be commercially profitable only because, through tariff protection, it can sell its product to the local market at protected higher prices. The difference between the protected price and the price at which the competitive import would be available represents a cost to the economy which should be made explicit by analysis.

32. To show such national costs and benefits separately from commercial profitability is not to answer the questions of policy to which they are related, such as "How much tariff protection is justified?" But to fail to break them out for consideration is to run the risk of making decisions which will later prove to have been faulty for failure to recognize and consider all of their consequences.

Application of the Test of Commercial Viability

33. Strange as it may seem, industrial projects sometimes receive the benefits of national subsidy, tax concessions, and even investment of public funds when careful analysis would have shown that, for technical or commercial reasons, they can never be financially successful. There are many interested parties whose return from the initiation of a project will be secured before the early years of operation have passed and whose support of the project is given without concern for its long-term success. Protecting the program from the influence of such special interests can be achieved only through painstaking analysis of the commercial feasibility of each significant industrial project at a high level of competence. One way of securing such analysis is by arranging for the participation of substantial industrial or banking interests under terms that will make certain that the investment is not fully paid out until commercial viability has been demonstrated. Another is to provide the technically qualified staff directly or through securing competent independent advisors. Regardless of method, the function is an indispensable substantive element of successful industrial development strategy.

## Creative Use of Technology

34. It is hard to imagine a successful industrial development program which does not make use of a wide range of technical analysis. Even in the preliminary screening of an economy for identification of sectors of industrial opportunity, the insights of an experienced team of industrial specialists, trained in the engineering and management sciences, can enrich and illuminate the judgments of administrators, economists and managers. The possibilities for adaptation of processes practiced in the earlier stages of the more advanced economies for application under current and usually more limiting requirements of scale and complexity in a developing economy can best be analysed by the experienced technologist. Furthermore, the wide range of industrial operations and processes to be analysed in the course of project feasibility studies demands the availability of a similarly wide range of technically qualified industrial specialists. Fortunately, conditions of transportation and communication in today's world make available such services from the resources of the more highly industrialised economies through a variety of institutions and firms. Wise use of such resources is another key to a successful industrial development program.

## Respect for the Capacity of Research and Recognition of Its Limitations

35. Most successful industrial development programs put great reliance on both economic and technical research to illuminate problems which must be resolved by the decision maker. Experienced managers and administrators, whether in industry or government, know the value of a cold shower of facts in a heated controversy over plant location, level of subsidy, competition among suppliers, or project selection. The countervailing principle - that all technical analysis falls short of the subtle but overwhelmingly important intangibles of politics, human relations, taste, and "hunch" - is of at least equal importance and perhaps in more danger of being overlooked in the increasingly professionalised field of industrial development. A nice balance is of the essence of success.

## A Climate for Enterprise

36. Finally, an industrial development strategy for an enterprise economy will most certainly fail unless it provides the preconditions which evoke enterprise: civil order and good government, reasonable economic stability, laws which encourage risk-taking, and a physical infrastructure - transportation and utilities capable of supporting an industrial effort. More subtle, but more far-reaching and fundamental than any of these, is the creation and sustenance of an attitude in society which sees in the man of enterprise a symbol of what the society values. To the extent that this occurs, all other measures will be facilitated.

* * * * *

37. To catalogue the institutional, the procedural and the substantive elements which comprise a successful industrial development strategy is not equivalent to designing it. Designing a strategy is not equivalent to executing it. As in all human affairs, the link in the chain of circumstance supplied by the administrator is indispensable if desire is to culminate in achievement. Nonetheless sound theory maximizes potential and minimizes risk. It can be disregarded only at peril.

1713 E - Nov.1962 - 1,600

E/CONF.39/D/183
SUMMARY
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

**SUMMARY**

Agenda Item : D.1

United States of America

# THE STRATEGY OF INDUSTRIAL DEVELOPMENT

By William A. W. KREBS,
Vice President,
Arthur D. Little, Inc.,
Cambridge, Massachusetts,
U.S.A.

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# THE STRATEGY OF INDUSTRIAL DEVELOPMENT

by
William A. W. Krebs, Vice President
Arthur D. Little, Inc., Cambridge, Massachusetts, U. S. A.

1. Designing a strategy for industrial development in an enterprise economy is still more art than science. Nonetheless, experience acquired over the last twenty years beginning with Operation Bootstrap in Puerto Rico yields principles that have value and which may, when summarized, be regarded as the elements of strategy for industrial development having general applicability to the needs of the less-developed areas of the world. This paper collects and examines these principles, their values and their limitations as a basis for policy.

2. The elements of an industrial development strategy may be classified as institutional, procedural and substantive.

3. The key institutional element in successful industrial development strategy is a central executive organization having high professional competence and political power. Such an organization must have at its disposal, and integrate the efforts of, a range of ancillary specialized institutions. Many of these have emerged only recently as tools of industrial development and are still experimental and evolving: development banks and corporations, technical assistance institutes, industrial development centers, planned and managed industrial districts. Over the longer term, the executive organization must support, or if they are missing, create indigenous institutions concerned with the intellectual infrastructure of industry, which educate, train and inform an expanding cadre of industrial manpower, from skilled labor to executive management and the service professions.

4. A key procedural element in successful programs of national scope appears to be the early formulation and use of quantitative objectives, finite in units of time, production, establishments and employment. These must be consistently related to the national economic development plan, if one exists, and to the nation's resources. Formulation of such objectives, and the measurement of a program's achievements against them, does not imply or require governmental direction or control of economic activity and thus is not inconsistent with the operation of an enterprise economy. Of nearly equal importance to quantitative objectives is adherence to a system of priorities logically related to them. Neither objectives nor priorities will have value unless measurements and policy decisions are based on sound economic research. Well-conceived and energetic promotion of investment in industry is a fourth essential procedural element.

5. The substantive elements of an industrial development strategy are the most diverse, specialized to each situation, and controversial. Of crucial importance is orientation of the program to knowledge of the market, present and potential. Scarcely less significant is a policy of integrated development in which projects are evaluated in terms of their capability for meshing into the growing economy. A third essential substantive element is consistent application of the test of

national economic benefit. Since commercially uneconomic industrial projects are of negative value, the test of commercial viability is also essential. Technology must be applied imaginatively both to maximize the value of resources and to create new products and services adapted to the economy and culture. Respect for the capacity of research to illuminate policy decisions must be balanced by recognition of the proper role of political judgment. Finally, but pervasive in its importance in economies in which reliance is placed on private enterprise, is the maintenance of a legal and political environment in which there is expectation of fair return on capital and human investment.



S - 1713 E - Nov.1962 - 1,600

E/CONF.39/D/184
12 Nov.1962
ORIGINAL : ESPAÑOL

CONFERENCIA DE LAS NACIONES UNIDAS
SOBRE LA APLICACION DE LA CIENCIA Y LA TECNOLOGIA
EN BENEFICIO DE LAS REGIONES MENOS DESARROLLADAS

Punto del programa : D.3.3

México

# LAS NORMAS Y ESPECIFICACIONES EN LA CONSOLIDACION INDUSTRIAL DE LOS PAISES MENOS DESARROLLADOS

Por Feliciano GARCIA RAMOS,
Plan General del Gasto Público,
Presidencia de la República,
México

Las monografías presentadas en la Conferencia de las Naciones Unidas sobre la Aplicación de la Ciencia y la Tecnología en Beneficio de las Regiones Menos Desarrolladas constituyen documentos de trabajo de dicha Conferencia. Se publican tal como han sido presentadas por los colaboradores y los puntos de vista expresados en ellas corresponden a los colaboradores. (Veanse notas al dorso.)

## NOTAS

1. Las monografías seleccionadas para las Sesiones Generales serán distribuidas en la Conferencia en los siguientes idiomas oficiales de las Naciones Unidas: español, francés, inglés y ruso.

2. Las monografías seleccionadas para las Sesiones Especiales serán distribuidas en la Conferencia únicamente en uno de los idiomas oficiales antes indicados.

3. Los resúmenes de las monografías presentadas por los colaboradores serán distribuidos en la Conferencia en los siguientes idiomas oficiales de las Naciones Unidas: español, francés, inglés y ruso.

4. No se procederá a la distribución general de las monografías y resúmenes con antelación a la Conferencia. Unicamente serán publicadas en cantidades limitadas con antelación a la Conferencia para uso exclusivo de las delegaciones de los gobiernos participantes y de otros participantes autorizados. La publicación con posterioridad a la Conferencia y la distribución general de las actas y debates de la Conferencia seguirán las prácticas de las Naciones Unidas establecidas por la Junta de Publicaciones de las Naciones Unidas.

D. DESARROLLO INDUSTRIAL

D.3.3. ESPECIFICACIONES Y NORMAS.

"LAS NORMAS Y ESPECIFICACIONES EN LA CONSOLIDACION INDUSTRIAL DE LOS PAISES MENOS DESARROLLADOS."

1.- INTRODUCCION.

1.a.- La norma nacional como base del funcionamiento eficiente y de la organización óptima de la empresa industrial.

La norma nacional es una convención que define la calidad de un producto y que al adoptarse por una nación, se convierte en -- factor de orden en la industria y de facilidad en la organización del proceso de la producción lo que trae como consecuencias inme-- diatas, la elevación de la eficiencia de la producción misma, el mejoramiento de algunas condiciones en el intercambio comercial - nacional y una mayor satisfacción de los intereses del consumidor.

En efecto, durante la etapa de desarrollo de la industria, -- surgen problemas provocados por la falta de organización y por -- las exigencias de mejores calidades por parte de los consumidores, que sólo pueden ser resueltos por medio de la norma, supuesto que ésta proporcionará las especificaciones del producto, los métodos de análisis del mismo y de control de calidad de materias primas y productos terminados, así como del producto en proceso de fabricación.

1.b.- Sin embargo, la norma, una vez aceptada y en operación, puede dejar de ser útil si el desarrollo de la técnica permite al fabricante superar las especificaciones contenidas en ella, de la misma manera que una norma puede no ser útil si sus especificaciones definen una calidad superior a la que técnicamente es posible obtener en el momento en que la propia norma entra en vigor. Esta situación plantea la necesidad de que el organismo nacional de -- normalización sea suficientemente ágil para conservar las normas al día y de que las normas se preparen de modo que estén de acuerdo con el desarrollo tecnológico actual del país.

2.- PRINCIPIOS GENERALES.

2.a.- Ubicación de la especificación dentro del funcionamiento de la empresa y sus principales reflejos en la productividad.

La especificación propiamente dicha es el recurso mediante el cual se define una calidad y consecuentemente su determinación -- tiene una influencia considerable en varios de los aspectos importantes del funcionamiento de una empresa, como por ejemplo, en el caso de que las especificaciones definan una calidad baja, se fa-

cilita la producción, y se aumenta la productividad; en cambio - se pierden mercados al no poder competir con la calidad de otros productos similares. En el caso opuesto, el de que las especificaciones definan una muy alta calidad, entonces se dificulta la producción, se reduce la productividad, se aumenta el costo del producto y, eventualmente, se obstruye su venta al consumidor. Consiguientemente, la elección de las especificaciones, particularmente aquéllas que definen en lo fundamental la calidad del - producto, debe ser motivo del máximo cuidado para asegurar, en - primer lugar, la calidad que sea necesaria, de acuerdo con el -- uso a que se destine el producto, en segundo, la productividad - más alta en la fábrica y finalmente un costo, para el consumidor, compatible con la calidad obtenida y las ventajas que su uso reporte.

2.b.- Relación de la especificación con la norma nacional, - regional e internacional.

La especificación contenida en la norma de un país, usualmente difiere de la especificación correspondiente a la norma de -- otro país, puesto que la norma nacional refleja algunos aspectos del desarrollo industrial y responde a factores tales como las - costumbres, la posición geográfica, el clima, etc. Estas diferencias en las especificaciones son un escollo para el fácil intercambio comercial entre países, que se reduce considerablemente -- con la adopción de normas regionales e internacionales, en las - que las especificaciones representan un compromiso entre los intereses de los diferentes países. Los elementos que intervienen en la elaboración de las normas regionales e internacionales y - que determinan la posición de cada país, son: el estado de desarrollo industrial, el producto mismo, el volumen de la producción, el precio del producto, los grados de calidad con que el - producto se ofrece y los propios países que concurren en competencia en el mercado regional ó internacional. Es obvio que la - elección de una especificación para una norma regional ó internacional, debe ser consecuencia de un amplio estudio tanto del producto como del mercado correspondiente.

Cuando entre diversos países se entablan relaciones comerciales estrechas, las correspondientes normas nacionales pueden derivar, a su vez, especificaciones concordantes que faciliten dicho comercio. El acuerdo correspondiente dá lugar a la norma regional. En sus niveles más altos, cuando se logra esa armonía de criterios entre el mayor número posible de países a través del - organismo encargado de promover dichos acuerdos, se alcanza la - norma internacional, cuyo logro es un avance considerable de la industria, del comercio y de la tecnología mundial.

2.c.- Jerarquía de normas y especificaciones.

Se entiende por jerarquía de normas, el orden en que éstas - deben ser preparadas dentro del proceso de normalización de un - país. De allí que la solución de este problema tenga la mayor importancia en aquellos países que empiezan la normalización de -- sus productos, ya que, evidentemente, deben existir productos cu

ya normalización sea urgente desde el punto de vista de el interés económico del propio país -casos de exportación- o del consumidor nacional.

En efecto, este punto de vista puede utilizarse como criterio para establecer la jerarquía de los productos para su normalización. Con mayor detalle, se puede decir que los aspectos que permiten definir el sitio de un producto dentro de la producción nacional, son: su importancia económica en tanto artículo de consumo nacional; su importancia económica como artículo de exportación; su importancia como factor de desarrollo industrial nacional; su importancia como factor de conservación de la salud del consumidor.

Se requiere por tanto un estudio amplio y profundo de la economía local, para establecer la jerarquía de los productos nacionales y poder proceder a su normalización.

Por otraparte, en el caso de las normas regionales o internacionales, los criterios que pueden usarse para proponer la normalización de un cierto conjunto de productos afines, son su importancia en el comercio regional ó internacional y su importancia como factores que favorezcan la industrialización de los países de la región o del mundo.

2.d.- Las normas técnicas en las actividades vitales de la economía de un país.

Es en el campo industrial en donde la normalización se ha aplicado con mayor frecuencia. Sin embargo, dondequiera que se realicen actividades repetitivas pueden obtenerse los frutos de la norma. La agricultura, la ganadería, la administración, los servicios públicos, los transportes, las comunicaciones, el comercio, la banca, etc. están en posibilidad de aprovechar la norma como elemento de racionalización y de simplificación. En diversos casos dentro de las ramas citadas se han logrado, a través del tiempo, la tradición y la costumbre, el establecimiento de formas y procedimientos prácticamente normalizados. Sin embargo, quedan aún abiertas las posibilidades de lograr otros aciertos, sobre todo, en lo que toca a nomenclatura y terminología.

De los párrafos anteriores, se deduce la participación de las normas técnicas en la economía de un país. En efecto, los elementos de orden que la norma introduce en las actividades industriales, comerciales, técnicas y científicas, se traducen en mejoramiento de dichas actividades al constituírse la norma en punto de referencia y estímulo y determinan, por ende el fácil intercambio comercial y el incremento del desarrollo tecnológico.

3.- EVOLUCION DE LA NORMALIZACION EN LOS PAISES ALTAMENTE DESARROLLADOS.

3.a.- A pesar de que el origen de las normas se remonta a los albores mismos de la civilización, a la época en que la conviven-

cia humana empieza a exigir normas de vida, como fórmula de subsistencia y de conservación de la especie; no obstante que el advenimiento de formas más evolucionadas de vida crean la necesidad de establecer reglas comunes de acción, de transacción, de valuación, etc., van designando la normalización como tendencia contraria al desorden, al despilfarro y a la disipación; no obstante que el desarrollo industrial de la humanidad continúa realizándose durante muchos siglos hasta llegar a la "Revolución Industrial" del siglo XVIII que, con el "maquinismo" y sus problemas inherentes, reconoció la necesidad de la NORMALIZACION INDUSTRIAL, y a pesar, en fin, de la general aceptación de las bondades y conveniencias de la aplicación de los principios de normalización, no fué sino hasta principio del presente siglo que se tomaron las medidas adecuadas para aprovechar los beneficios de la normalización a NIVEL NACIONAL.

3.b.- La Gran Bretaña organiza el primer cuerpo de normalización en el mundo, en el año de 1901. Pero hubo de transcurrir -- buen número de años desde que se fundó la Asociación Británica de Normas de Ingeniería y fué necesario que se sufrieran las --- amargas experiencias de la Primera Guerra Mundial, para que se reconociera en definitiva el papel decisivo de las normas industriales y para que los países que intervinieron en la contienda procedieran a organizar sus cuerpos nacionales de normalización, con la convicción plena de su carácter imprescindible en el desarrollo industrial y económico. De tal manera se ha relacionado el papel de las normas con la industrialización, que el número de éstas puede dar una idea aproximada de la magnitud del nivel alcanzado en dicha actividad; en la inteligencia de que la diversidad de temas que han sido motivo de normas en los países más avanzados, comprende ya no sólo los aspectos de la industria tradicional, sino también los más recientes nacidos de la tecnología moderna, de igual modo que abarca aspectos administrativos, comerciales y científicos.

3.c.- La normalización ha evolucionado en los países altamente desarrollados, hasta alcanzar niveles que se caracterizan por la existencia de organismos complejos, en los que participan técnicos del más alto nivel en todas las especialidades y que cuentan con grandes recursos, con la información técnica más avanzada y con laboratorios de investigación tecnológica y científica de primer orden en el mundo, lo que explica que sus estudios, no sólo se aprovechen en los trabajos de normalización, sino que -- tengan importante repercusión en el desarrollo de nuevas técnicas para los procesos de fabricación, y que las normas que han elaborado, no sólo se empleen en el propio país, sino también en el extranjero, particularmente los países de escaso desarrollo industrial.

Por eso es indispensable señalar, como uno de los aspectos negativos en la evolución de la normalización, sobre todo en los planos regional e internacional, el relativo al uso de diversos sistemas de unidades de medida en el mundo, pues tal disparidad ocasiona dificultades en el intercambio comercial y tecnológico,

especialmente entre los países en que el sistema de unidades de medida es de uso obligatorio. Ya se advierte una tendencia mundial hacia el uso generalizado del sistema métrico decimal, como consecuencia de la creación de zonas de libre comercio, que incluyen países que tienen establecidos diferentes sistemas; pero debe lucharse por la consecusión de la más completa uniformidad.

4.- EVOLUCION DE LA NORMALIZACION EN LOS PAISES MENOS DESARROLLADOS.

4.a.- En estos países, la evolución de la normalización ha alcanzado sólo las primeras etapas y se caracterizan por la --- existencia de organismos de normalización con pocos técnicos de alto nivel y escasas facilidades para la investigación tecnológica y científica. Dependen, de manera muy importante, de las facilidades que la iniciativa privada aporta para el desarrollo - de la normalización, bien sea en forma de asistencia técnica o mediante el otorgamiento de facilidades para la investigación. Además, el número de normas elaboradas es escaso y están fuertemente influenciadas por normas extranjeras. Puede asegurarse -- que en todos los casos en que se opera con productos que no han sido normalizados, de manera sistemática se recurre a las normas extranjeras, ya provengan de un país determinado, o de una organización regional o internacional.

Por eso se ha afirmado que en términos generales, el desarrollo de la normalización es semejante o paralelo al desarrollo industrial de un país, pues existe una interacción entre - el desarrollo tecnológico y las normas, en virtud de la cual -- uno mejora a las otras y viceversa; es decir, la normalización surge del propio desarrollo industrial y se revierte sobre él,- para estimularlo.

5.- ORGANIZACION DE LA NORMALIZACION A NIVEL NACIONAL.

5.a.- Como consecuencia de sus condiciones de desarrollo industrial, cada país organiza la normalización de sus productos en forma diferente; pero es posible señalar algunos rasgos comunes a toda organización: en primer lugar, los objetivos de la - normalización, que son: la satisfacción del interés nacional, - por el estímulo que significa la normalización para el desarrollo industrial, y la protección de los intereses del consumidor en virtud del orden que introduce la normalización en la producción nacional y en el intercambio nacional e internacional; en segundo lugar, la existencia de un organismo con carácter nacional oficial o privado, específicamente encargado de la normalización; y, finalmente, la concurrencia a los actos de normalización -elaboración de normas, desarrollo de métodos de prueba, - etc.- de todos los sectores interesados -productores, consumidores, técnicos y gobierno-.

Las modalidades peculiares de la organización y desarrollo de cada país, harán que se dé énfasis variable a los diversos - factores de normalización y objetivos de la misma, como a la --

protección del consumidor, a la participación de los técnicos, - a la influencia directa del gobierno en los actos de normaliza-- ción, etc.

Sin embargo, se indudable que en los países de escaso desa-- rrollo, la asistencia técnica dirigida hacia la organización de la institución nacional de normalización, será de gran utilidad porque estimulará su desarrollo, y que, por otra parte, el inter cambio de ideas entre los diferentes países, la normalización re gional y la internacional, propiciarán el desarrollo de la norma lización en cada país, dentro de la tendencia de alcanzar las me tas que, hasta ahora, sólo han logrado los pueblos más avanza--- dos.

5.b.- No debe pasarse por alto, al hablar de normalización na cional, la necesidad de establecer "marcas" o"sellos de garantía" como culminación tangible de los esfuerzos que concurren al esta- blecimiento de un conjunto de especificaciones aceptadas unánima- mente ya que cuando un producto merece ostentar la "marca" o el - "sello de garantía", quiere decir que ha sido manufacturado respe tando las características acordadas con intervención del consumi- dor, y que garantizan un mínimo de calidad, de seguridad y efi-- ciencia en el uso a que se destina, independientemente de que --- constituye un estímulo para el industrial que fabrique artículos de buena calidad y de que contribuye a consolidar el mercado exte rior.

6.- CONCLUSIONES:

Como consecuencia de lo expuesto, se infiere una conclusión - inmediata: es urgente estimular, acelerándolo en la medida de lo - posible, el desarrollo de la normalización en los países menos de sarrollados, y al efecto, debe estudiarse la conveniencia de que - se organice una amplia y eficaz asistencia técnica, en los proble mas de normalización en general, mediante el otorgamiento de be-- cas que permitan la especialización y la práctica en los organis- mos más adelantados; autorizando el envío de expertos que puedan participar en la organización misma de los cuerpos nacionales de normas, en los países que carezcan de ellos, o en la reorganiza-- ción y funcionamiento de los cuerpos ya existentes, preparando -- programas para la elaboración de normas, jerarquizando la impor-- tancia de los productos de acuerdo con las condiciones de cada -- país, sugiriendo métodos de trabajo y de difusión de la normaliza ción en el medio nacional y estableciendo un servicio permanente de consulta; proporcionando, en fin, el auxilio necesario para -- que se establezcan laboratorios nacionales, como auxiliares indis pensables de los cuerpos nacionales de normalización, así como -- los elementos para que en las universidades e institutos de ense-- ñanza técnica superior, se establezcan cursos adicionales sobre - normalización a los niveles de empresa, nacional, regional e in-- ternacional.



1263 S - Nov.1962 - 600

E/CONF.39/D/184
SUMMARY
29 Nov.1962
ENGLISH
ORIGINAL : SPANISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

SUMMARY

Agenda Item: D.3.3

Mexico

# STANDARDS AND SPECIFICATIONS IN THE INDUSTRIAL CONSOLIDATION OF THE LESS DEVELOPED COUNTRIES

By Feliciano GARCIA RAMOS,
General Plan of Public Expenditure,
Presidency of the Republic,
Mexico

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# STANDARDS AND SPECIFICATIONS IN THE INDUSTRIAL CONSOLIDATION OF THE LESS DEVELOPED COUNTRIES

By
FELICIANO GARCIA RAMOS, GENERAL PLAN OF PUBLIC EXPENDITURE, PRESIDENCY OF THE REPUBLIC, MEXICO

1. INTRODUCTION - The national standard is the appropriate guide for industry, indicating principles of order, organisation, systematisation, etc. for the process of production, for the nation's commerce, and for satisfying the consumer's interests. Within the context of a country's development this agreed standard is a phenomenon which arises at a certain point of that development, as the productive forces ripen, so that efficient running of industrial concerns may gradually be attained by matching the organisation of the concerns to the requirements of standardised production and consumption.

2. GENERAL PRINCIPLES - When applied to an industrial firm, the national standard is a technical device for the rationalisation and simplification of products and processes and bids fair to reduce industrial costs and channel the concern's efforts toward improvement of output.

National, regional and international standards facilitate the exchange of goods and services between countries as well as making possible close scientific and technical cooperation.

The grading of standards with a view to establishing priorities within a national standardisation programme is considered indispensable, and must be based on an analysis of a whole series of factors such as economic importance, outlay involved, size of product, imports and exports, etc.; in short, a whole series of factors which give momentum to industrial development. This is what a correct grading of standards effectively aims at.

3. GROWTH OF STANDARDISATION IN HIGHLY DEVELOPED COUNTRIES - In the highly industrialised countries, levels of standardisation have been attained which satisfy the need of those countries to hold their own in commercial competition on the basis of suitable prices and frequent technological improvements for the benefit of national consumption, as well as to keep up positions of prestige in foreign markets which are of substantial importance for their economies.

However, certain countries still maintain anachronistic systems of weights and measures which are obviously prejudicial to international standardisation and to the spreading of technology and culture.

4. GROWTH OF STANDARDISATION IN THE LESS-DEVELOPED COUNTRIES - The vast majority of the under-developed countries lack national standardisation institutes and the few that exist do not function as required by the present industrial development of those countries, i.e. they do not meet the needs of accelerated industrial development.

Instituting such bodies, or else improving the existing ones, regardless of whether private or official, is therefore indispensable, particularly in view of the fact that their activities will in principle be aimed at promoting industrial development and protecting the interests of the ultimate consumers.

The "mark" or "seal of guarantee" is the consequence of good standardisation practices, and should be mentioned because it contributes to creating in the consumer an awareness of what the standard signifies and induces industrial and commercial competition resulting in greater advances.

5. ORGANSIATION OF STANDARDISATION AT THE NATIONAL LEVEL - Since the aims of standardisation are to meet the national interest by the stimulus it imparts to industrial development, and to protect the consumer's interests by virtue of the order it introduces in national production and in national and international commerce, there can be no doubt about the importance of organising standards at the national level and of setting up or improving the organisation responsible for discharging that function. Since standards are a product of the competition between all the sectors involved - producers, consumers, technicians and government - the benefits of standardisation will be fully felt and will provide a stepping stone to the more advanced stages of regional and international standardisation.

6. CONCLUSIONS - It is a matter of urgency to stimulate the development of standardisation in the less developed countries via ample and effective technical aid ranging from general matters of standardisation, and passing via the actual organisation of national standardisation bodies in the countries lacking them or else the re-organisation and renewed functioning of those already existing, to the creation of national standardisation laboratories and the institution of extra courses on standardisation in universities and technical and higher educational establishments and firms at national, regional and international level.



S - 1263 E - Dec. 1962 - 1,600

E/CONF.39/D/185
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.1.3

United States of America

# THE POTENTIAL OF THE COMPUTER AND HIGH-SPEED INFORMATION PROCESSING TECHNIQUES FOR INDUSTRIAL DEVELOPMENT

By Dr. Thomas VIETORISZ,
Research Division,
International Business Machines Corporation,
Yorktown Heights, New York

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# THE POTENTIAL OF THE COMPUTER AND HIGH-SPEED INFORMATION PROCESSING TECHNIQUES FOR INDUSTRIAL DEVELOPMENT

D.1.3

by
Dr. Thomas Vietorisz
Research Division
International Business Machines Corporation
Yorktown Heights, N. Y.

## I. Introduction

1. The selection of promising new lines of industrial growth for a developing country is an art which attempts to draw equally on new concepts in economics and new horizons in technology. The needs of the developing areas are more often than not very urgent, and every practitioner in this field who has had to face the responsibility of coming up with recommendations for concrete action in particular cases is perennially seeking for new ideas, new approaches and new alternatives that offer a hope of cutting through the many vicious circles which surround the problem on all sides.

2. This paper is a report of an admittedly summary survey of the new field of high-speed computation and information processing, which has been conducted in search of such new concepts and approaches to the problem of planning industrial growth. The survey has turned up two ideas of great promise: the application of numerically controlled fabrication processes to the end of breaking the constraints which prevent the economical operation of the engineering industries in many of the less developed areas; and the application of a systems approach, based on high-speed computers, to the problem of organizing an efficient information-gathering and decision-making machinery in the field of industrial development planning. Most of the discussion in this paper is devoted to these topics. Other topics, of great interest in themselves but of lesser immediate significance to the less developed areas, are mentioned but briefly.

## II. Information Processing: Background

3. In the past decade, a veritable revolution has taken place in the science and technology of information processing. The modern electronic computing machine is the principal embodiment of the resulting advance, as well as the tool for the execution of the many highly complex tasks of data organization, storage and analysis which can now be successfully handled. It has been estimated that the capabilities of such machines have increased by several orders of magnitude over the past decade and a half, in terms of speed, memory capacity and reliability. The costs of the machines have increased concurrently at a much slower rate; thus, both the time and the resources required for the performance of a given data processing task have declined considerably.

4. Meanwhile, the difficulties of programming the computer (i.e., giving instructions to the machine) have been greatly reduced for a number of important areas of application, including mathematical calculations and the handling of textual material. This has been achieved by creating special codes which resemble closely the technical terminology ordinarily used in each one of these fields; the codes themselves are in such a form that they can be accepted directly by the computing machine as commands for the execution of complex series of operations. By this means, the computers have been made accessible to a wide range of potential users.

5. The principal payoff on the application of computers has so far come in

data reduction, i.e., in the digestion of enormous volumes of numbers for drawing specific conclusions. A spectacular example is the tracking of artificial satellites. Many complex mathematical computations also have become practical for the first time. Recently, information processing systems based on electronic computers have been introduced for the replacement of routine clerical effort in commercial organizations, i.e., the clearing of bank cheques, the calculation of payrolls, certain accounting functions, etc. Currently, a large new field of expansion is in the control of physical operations in the manufacturing industries, both in fabrication and in continuous-flow processes; and in the design and operation of complex interacting systems such as are encountered, for example, in the management of business firms.

6. From the point of view of the less developed areas, the control of fabrication processes by means of the techniques of information processing is of especial interest, since it promises to open up a major new avenue of industrial development. This technology is referred to as numerical control. The following sections will be devoted to this topic. Thereafter, other direct contributions to industrial production will be briefly mentioned, including on-line process control and operations scheduling. Finally, the contributions of information processing to the techniques of planning and decision making in the field of industrial development will be discussed.

## III. Numerically Controlled Fabrication Methods

7. Numerical control of a fabrication step signifies the automatic execution of operations by a machine on the basis of commands coded in a punched paper tape or other information-carrying medium. For example, a numerically controlled milling machine or other machine tool will execute a complex series of metal cutting operations which have been decided upon in advance by the designing mechanical engineer. High-speed computing machines intervene in translating the physical design into coded instructions which prescribe the behavior of the machine from moment to moment in minute detail, including position, speed, feed rate, tool and coolant selection, etc. After the coded control tape has been prepared, a part can be produced automatically at any time without further human intervention except, usually, the loading and unloading of the machine.

8. Numerical control is available at present for most metal cutting machine-tool operations, and for a variety of other fabrication processes, including pipe and tube bending, motor and coil winding, flame cutting and seam welding, riveting, various kinds of assembly, and the inspection of products. Applications contemplated for the near future include forging, stamping, extrusion, wire and strip bending and many other operations.

9. In 1961, there were about 2000 numerically controlled machine-tools installed in the United States; sales totalled 100 million dollars, representing one-sixth of all machine tool sales. Yearly sales have approximately doubled from year to year; it is forecast that by 1965 anywhere from one to two-thirds of all machine tool sales will be of the numerically controlled type. At present, there are about sixty manufacturers of numerically controlled machine tools and about half that many of control equipment.

### A. Advantage of Numerical Control

10. Numerically controlled fabrication methods promise to enlarge greatly the range of metal transforming and fabricating industries that can be operated economically in many of the less developed areas. The principal factors tending to produce this result are: (a) a drastic lowering of the minimum economic scale; (b) a reduction of the level of operator skills required; (c) a guarantee of uniform product quality; and (d) an achievement of these benefits at favorable unit capital costs. The difficulties which will have to be overcome in bringing this promise to fulfillment are considerable, but the potential benefits are so great that a large effort is well worth while.

11. The discussion is centered on numerically controlled machine tools, since

they furnish a good example both of the advantages offered by numerical control and of the problems raised by it. Moreover, the best information is available in regard to these machines.

(a) Minimum Economic Scale

12. The reduction of the minimum economic scale is the result of the high productivity of numerically controlled machine tools which is not dependent on production runs consisting of large lots of identical workpieces. Numerical control is characterized by extraordinary flexibility in production. Special tooling, jigs, fixtures and templates are almost completely eliminated, since the control tape automatically positions the workpiece in relation to the cutting tool for each cut, with a high degree of accuracy. As a consequence, the time required for setting up a production run, or for changing over from one run to another, is reduced from hours or days to minutes or even less. Thus the two principal dis-economies connected with the production of small lots are eliminated; namely, the high unit cost of jigs, fixtures and special tooling, and the high unit cost of set-up time.

13. The advantages of numerical control in respect to economics of scale have to be evaluated in relation to two types of conventional operations: the job shop, producing a large variety of products on standard machine tools, in relatively short series (typically, from a few pieces to a few hundred pieces per lot, occasionally more); and the mass-production plant, producing thousands of identical or nearly identical pieces on specially designed and built machine tools rigidly coordinated into production lines. In assessing the relative significance of these two types of production, it should be noted that in the United States about three quarters of the dollar value of all metalworking products originates in series of twenty-five units or less. Numerical control leads to a drastic cost reduction in the production of job shop products, and it can virtually eliminate cost differences between shorter and longer runs within this range. Thereby, one of the key disadvantages of the less developed areas in the manufacture of such products, stemming from the narrowness of their local markets and correspondingly high unit costs resulting from the use of conventional techniques, is largely overcome.

14. Turning now to a comparison with mass production, it is generally conceded that under conditions such as prevail in the United States, numerical control results in higher unit costs. In certain circumstances, nevertheless, the capital investment in numerically controlled machines for producing the same volume of output may turn out to be approximately equal to that of conventional mass-production equipment, and in this case the cost advantage of conventional mass production is primarily due to labor savings. This may happen when a flexible numerically controlled operation is able to replace more than one independent mass production line. Little experience is available on this point, and professional opinions differ. It is, however, not in doubt that the flexibility of numerical control is often highly attractive in comparison with the rigidity of a mass production line; this is an especially significant consideration when engineering improvements and model changes on a product are frequent or when the market is unpredictable. Thus, by reliance on numerical control techniques, the less developed areas may find it possible to compete even against certain types of mass production, without finding themselves at nearly as much of a comparative disadvantage as they customarily encounter at present. More significantly, in the manufacture of such products, the productivity of their scarce capital resources can be raised close to the level attainable by mass production in the broad markets of the industrialised countries.

(b) Operator Skills

15. Numerical control reduces the need for highly skilled operators. Whereas the hand operation of machine tools, especially of the complex and high-precision types, has the nature of a craft which is perfected during a lifetime, the operation of numerically controlled machinery primarily involves, beside loading and unloading, chip clearing and changeover, the monitoring of the machine for the regularity of its mechanical performance. The required level of skills is therefore lowered, even though the job is a responsible one. Moreover, the need for

job classifications corresponding to specialized classes of machine tools disappears, as the nature of the work is identical in all cases. As a consequence of these two factors, the adoption of numerical control techniques reduces the pressure of the scarce skilled-labor resources of the economy: the lower-level skills required can be provided by means of a much shorter training period. Furthermore, the elimination of job classifications permits the shifting of workers between machines, thereby reducing absenteeism problems. Work incentive plans can also be eliminated and replaced by flat rates, since the rhythm of operations is fully determined by the control tape.

16. In sum, the limitations of scarce skills on the growth rates of the economies of the less developed areas become less binding.

(c) Product Quality

17. Numerically controlled machining has the advantages of consistently high quality. Tolerances are coded into the control tape and automatically maintained. This results in a high degree of accuracy, repeatability, and in an excellent mutual fit of workpieces during assembly. The effects of worker fatigue are eliminated; spoilage is greatly reduced, to the point where the entire nature of quality control can be changed, at substantial savings. Apart from sporadic tool breakage and comparable accidents, no rejects are produced; therefore, a major proportion of inspection effort can be dispensed with, and replaced by a periodic inspection of the machines themselves rather than of the parts produced.

18. Consistently high product quality makes numerical control especially suited to the conditions of the less developed areas, since at present the problems of quality are of perennial concern and discourage the initiation of many lines of manufacture.

(d) Capital Productivity

19. Numerical control leads to greatly increased productivity of capital when compared with job shop production, and compares rather favorably even with conventional mass production techniques, as pointed out earlier (see paragraph 14).

20. Individual numerically controlled machine tools are more expensive than their conventional counterparts, but comparison is often difficult, since numerical control leads to a change of functions, in the direction of greater universality of the individual machine. The price differential ranges anywhere from 25% to 100% and even 200%, depending on exactly how much auxiliary equipment is included in the comparison. The technical development of these machines is also very rapid; there is a wide range of alternatives on the market, from conventional machines adapted belatedly to numerical control, to modern machines conceived from the beginning for full integration between operational and control functions.

21. Unit capital costs are favorable, since the productivity of a machine is generally increased by more than its price, and there are additional capital savings on account of floor space and inventory.

22. The largest improvements are due to an increase of the fraction of shift time the machine is actually engaged in removing chips. For conventional operations, this ratio is of the order of one quarter, on the average, while with numerical control it increases to the order of three quarters. This better utilization is due to the very short set-up and change-over times, the versatility of the machines which permits a larger number of operations on a single machine, thereby cutting down on the shuttling of workpieces between machines and the resulting bottlenecks on some machines and slacks on others, and the fact that machines in conventional job-shops are often kept idle in order to save a particular set-up. Such an improvement in machine utilization is especially significant because cutting speeds have been increased already to the limit with conventional equipment, and little remains to be gained in that respect; still, numerical control shows some gain on this account also, due to higher speeds near the edges and corners of the workpiece and generally, in the late stages of a complex and expensive job, where a human operator would tend to proceed with extra caution.

23. Savings in floorspace are a direct result of higher machine productivity and lower in-process inventories; moreover, the versatility of the individual machines decreases layout problems. Both floor space and inventory savings are also obtained because a piece is fully machined in a short time with less of the usual queuing and accumulation of workpieces on the production floor between machines. In addition, inventories of finished products can also be kept at a very low level, since additional pieces can be easily run off as needed by use of the existing control tapes.

B. Problems Associated with Numerical Control

24. The advantages listed above appear almost too favorable to be true; and, in fact, there are some serious problems to be overcome before the full payoff on numerical control can be obtained in the less developed areas. Given a sufficient effort, however, numerical control does in fact offer a technological means of breaking through the customary vicious circles posed by restricted markets, missing skills, and the scarcity of capital goods.

25. The principal problems arise from (a) the minimum scale required for running a numerically controlled production system (as distinguished from the scale of production of a single product); (b) from requirements for new skills; (c) from the need for special attention to machine reliability; and (d) from the fact that a large plant of the kind envisaged, which could take full advantage of the benefits of numerical control, represents a genuine technological innovation.

(a) Scale of System

26. The full benefits of numerical control are difficult or even impossible to realize on a gradual basis in the less developed areas, since numerical control has to be applied to a wide range of individual operations before any finished product can be produced largely by this technology. Some operations, like the production of nuts and bolts, will probably never be worth performing by numerical control, but even so, the variety of operations involved in fabrication and metal-working is large enough to make an integrated numerically controlled plant a major industrial unit. The productivity of such a plant is enormous, and keeping it running around the clock poses the basic problem. Even in industrialized countries, two-shift operation of numerically controlled equipment is practically mandatory for economic reasons; in the less developed areas, it would be a major waste of capital productivity to run anything but three shifts. No detailed studies have been made of the necessary demand for products to keep such a facility busy, but it can be predicted confidently that even without the need for making any one product in large lots, the scale of the operation as a whole will easily surpass the demand available within the borders of many smaller countries. Thus, while the dis-economies of small scale can be overcome by means of numerical control in so far as individual products are concerned, they persist in relation to the production volume as a whole. Therefore, only the larger or higher-income countries will be able to set up such facilities on their own; for others, the only feasible approach seems to be a common effort. Moreover, it is evident that in many cases the necessary demand can be guaranteed only by means of a careful planning and coordination of a large variety of production lines which, in the highly industrialized countries, are customarily classified and organized as separate branches of the manufacturing industries. For example, it is entirely possible that the minimum scale requirement cannot be met without channeling portions of the production of agricultural equipment, automotive products, electric sub-assemblies, industrial equipment and consumer durable goods to a common facility of the kind indicated.

27. Economies of scale in relation to the system as a whole also arise from unified engineering design facilities and the sharing of electronic computing equipment. The huge productivity of the plant requires a very large engineering design effort, maintained on a steady basis, in order to provide control tapes for the operation of the machines. Initially, this requirement may perhaps be circumvented to some extent by obtaining control tapes from abroad, either in the form

of technical assistance or on a royalty basis; nevertheless, the full benefits of modern technology cannot be realized unless engineering design is steadily improved and adapted to local conditions. Thus, while tapes from abroad may be useful for starting up a plant, they cannot be relied on indefinitely.

(b) New Skills

28. While numerical control eliminates the need for operator skills, it creates a requirement for specialized maintenance, engineering design and management skills.

29. Maintenance skills involve experience in hydraulics, electronics, relay circuits and servo systems: they require specialized training of a higher level than the displaced operator skills, but the number of man-hours needed per unit of production is of course considerably lower, leading to a net saving of scarce skills. The requirements for skills in engineering design, control tape coding and production planning are, however, very large. The preparation of machine instructions from a finished design has been reduced from a ratio of 12 hours per hour of machine operation to a ratio of about 1:1, by means of powerful summary coding techniques which are translated into detailed machine control tapes by electronic computers; none the less, the total effort required is still very large, especially if the lots run off from each control tape are small. No doubt, the provision of a large pool of engineering talent for design and coding will raise considerable difficulties in many of the less developed areas. In many countries it may, however, be easier to train mechanical engineers than skilled craftsmen; moreover, it is logical that whatever pool of engineering talent does in fact exist, should be channelled toward occupations of the highest productivity. It should be added that major progess is now underway in the fields of computer-aided engineering design, numerically controlled drafting and several related fields, which promise to free the engineer from many routine functions, and also to reduce sub-professional staff requirements considerably.

(c) Reliability

30. A further problem is raised by special requirements for maintaining machine reliability. This includes some added investment costs, such as heavy foundations (to guarantee perfect leveling of the machines), or temperature and humidity controls (to eliminate a drift in tolerances). Preventive machine maintenance, as well as the regular sharpening and pre-setting of tools, becomes a necessity. All raw materials, whether purchased or internally produced (bar stock, sand-blasted castings, forgings, etc.) have to be as uniform as possible, since there is no way of making compensatory adjustments when the operations are under tape control. These factors place a special premium on competent management.

(d) The System as an Innovation

31. A large numerically controlled fabrication plant constitutes a highly complex system which has the nature of a genuine technological innovation. In the United States, numerically controlled machines have been introduced little by little into existing operations; in the less developed areas, however, the benefits of numerical control cannot be captured except by means of an integrated large production facility (see paragraph 26). The advantages of integrated systems over isolated machines have been strongly emphasized even for the industrialized countries: it has been conjectured that so called "system benefits" outweigh individual-machine benefits by perhaps as much as 2:1. It is of course true that in the industrialized countries, all kinds of fabricated metal products and machinery have been produced successfully for many years by conventional techniques; thus, there is less to be gained by the new technology than in a context where the need is desperate and the conventional methods largely inappropriate.

32. There has been little experience so far with systems of numerically controlled machines. In the United States, several large operations exist which incorporate as many as a few dozen numerically controlled machines; also, there are some small facilities entirely under numerical control. No integrated large plant of the type envisaged here, however, has yet been built.

33. Such a plant, with perhaps 50 numerically controlled units, would represent an investment of 5-7 million dollars in numerically controlled machines alone. Compared with the first cost of an integrated steel mill, this is not a frightening sum, but undoubtedly it represents a major commitment for any of the less developed areas.

34. The managerial skills needed for running such a plant are considerable, since there is a large penalty on operating the plant at less than full capacity. In designing a suitable system around numerical control, however, many powerful management control concepts and aides become available for the first time. The need for time studies, complex inspection systems and wage incentive systems disappears. Accounting is greatly simplified, since engineering design is translated into finished parts almost error-free; thus, estimates coincide closely with accounting figures. Production control is simplified, since much of the customary preparation of shop drawings, blueprints, inspection sheets and routing papers is replaced by direct commands to the machine through the medium of the control tape. Shop scheduling is also simplified, due to the diminished shuttling of pieces between machines. At the same time, however, whatever scheduling is still needed becomes more critical, due to the high premium on full-capacity operation; and the scheduling of preventive machine maintenance and tool control acquires an extraordinary significance.

35. All these factors point up the need for a careful preliminary study of such systems before commitments are made, and the design of each plant on the basis of up-to-date organizational and scheduling methods. It also appears that in many of the less developed areas, the proper way of establishing such a facility is by starting it up with a competent temporary foreign staff which is subsequently replaced as rapidly as possible by local personnel trained on the job.

### C. Benefits of an Engineering Industry

36. The possibility of manufacturing economically a wide range of metal transforming and fabricated products in the less developed areas has such obvious consequences for their economic development that it is hardly necessary to dwell on these consequences in detail. With a domestic industry capable of turning out machinery and equipment at a reasonable cost in terms of scarce resources, these areas will no longer find their potential savings dissipated and their growth strangled by foreign exchange shortages on the one hand and formidable dis-economies of capital goods production on the other. The domestic manufacture of a variety of capital goods, consumer durables and transportation equipment will, in any event, reduce the pressure on the balance of payments, and will thereby contribute to the possibility of importing those commodities whose domestic manufacture would be the least economical or entirely unfeasible.

37. A numerically controlled facility could make also an important contribution to improving the availability and reducing the cost of spare parts for imported engineering products. Given the cooperation of the manufacturers in the industrialized countries, it would no longer be necessary to carry large inventories; if the control tapes for the parts were made available, the parts could be produced locally as needed. As a long-term benefit, this would lessen the burden on a country of importing needed engineering products, and would thereby incidentally facilitate the marketing of such products. As a short-term benefit, it would permit coping with the exasperating array of engineering products of all types, brands and makes that now flood the markets of many of these areas. At present, the lack of availability or delay in obtaining needed spare parts, often due to foreign exchange problems, can lead to the idling of expensive productive machinery for long periods of time.

## IV. Other Contributions of Modern Information Processing to Industrial Development in the Less Developed Areas

### A. On-Line Process Control

38. The control of operations by means of computers in the process industries, so-called on-line process control, is a recent development in the industrialized countries. The purpose of this control may either be the optimization of process

variables in a highly complex, dynamic interacting system, to the end of obtaining better yields or higher qualities; or else, computer control may be introduced with the end of safety in mind - e.g., for the complex start-up and shut-down operations required in thermoelectric power stations, where the penalty on operator error can be a major accident. No doubt such computer control will in due course find its way into new plants built in the less developed areas, but it does not hold out the promise of any dramatic breakthrough, such as that indicated in the foregoing sections in relation to numerically controlled fabrication processes.

39. An interesting indirect benefit may, nevertheless, result from this new technology in the following way. On-line computer control promises to yield its greatest payoff in industrialized countries when totally integrated with a process from the beginning of design, rather than when added on as an afterthought to standard processes. In this way, it may have the effect of unfreezing standard engineering practices, with the hopeful consequence that engineers in industrialized countries will acquire more of the mental perspective which is needed for fresh approaches to the otherwise entirely different problem of capital-labor substitution, where progress so far has been minuscule.

B. Operations Scheduling

40. On-line process control, when applied to semi-continuous processes such as characterize for example the steel industry, merges into another new development connected with computers and information processing, namely, operations scheduling. This is the art of improving the efficiency of batch-type or semi-continuous operations subject to elements of uncertainty, by means of improving machine utilization, reducing materials handling, transportation and inventory requirements, improving product quality, and other related means. Operations scheduling depends on the careful analysis of mathematical models; this analysis, in turn, depends on high-speed electronic computers for all but the simplest kind of industrial situations, since the models become too large and involved for handling by any other means.

41. The importance of operations scheduling has been pointed out earlier (see paragraph 34) in connection with numerically controlled fabrication processes. In other applications, it also promises an improvement of productive efficiency; this is especially significant from the point of view of the utilization of scarce capital resources in the less developed areas. There are, however, limits to what operations scheduling can accomplish under the conditions typically prevailing in many of these areas. The efficiency of a given productive unit (plant, firm, organization) depends on two separate sets of factors: the internal ones, under the control of the unit, and the external ones, outside its control. Even with perfect internal operations scheduling, the productive unit can be at the mercy of such external destabilizing influences as tardy shipments from suppliers, unreliable qualities of purchased commodities, inability to obtain spare parts for vital machinery when needed, unpredictable changes in foreign exchange or licensing regulations, etc. In addition, many productive units are also burdened with misdirected investments.

42. Productive units which attempt to increase the efficiency of their internal operations under these conditions will often do so by isolating themselves, in so far as possible, from outside disturbances. This can be achieved by increasing the self-sufficiency of the unit: the integration of related functions, the increase of inventories of raw materials, supplies and spare parts, the acquisition of machinery for performing specialized operations that are needed only occasionally, etc. This strategy will succeed in raising internal efficiency, but only at the cost of increasing substantially the capital tied up in the process. Thus, it is not the best strategy from the point of view of industrial growth in the economy as a whole, since it raises the capital-output ratio.

43. Operations scheduling for the individual productive unit cannot improve on this outcome; the only effective way of handling the problem is to center the attack on the interrelations between productive units: in other words, to carry operations scheduling beyond the confines of the individual productive unit. This is entirely feasible, and in fact, it constitutes one of the important avenues of action in the

purposeful planning of industrial development.

## V. Contributions to Industrial Development Planning

### A. The Nature of Industrial Development Planning

44. The planning of industrial development involves an enormous task of information processing. The economy as a whole, and its industrial sector in particular, can be regarded as complex interacting systems. Government entities which take actions of economic significance (including public enterprises) and private firms make up the economic system. In particular, all entities with planning functions are also part of this system. The latter entities, however, are peculiar in this respect: they form a subsystem whose action and functioning is governed by policy objectives concerning the economy as a whole.

45. A great deal of advance has taken place in recent years in regard to the principles which govern the flow of information, the maintenance of centralized memory files, the division and interaction of functions and many related matters in the efficient management of large systems. Admittedly, no systems so far studied have exhibited the complexity of an entire economy or of one of its sectors. On the other hand, the purpose of studying the economic system from the point of view of industrial development planning does not embrace the problem of managing the entire industrial economy in all of its detail. A major portion of this detailed management is typically left to independent decision-making units, which may have the nature of private firms or of largely autonomous public enterprises. This reduces to reasonable proportions the task of studying the interrelations between the overall system and the planning subsystem.

46. Thus, in general, the planning subsystem will have a hierarchical part and a part comprising the collection of independent decision-making units. Planning for the system as a whole reduces to the spelling out of consistent policy objectives at the top decision-making level of the hierarchical part; in adequate communications up and down the line with the lower hierarchical levels, and an interaction between top-level and lower-level policy objectives; and in the establishment of a mechanism that will bring an adequate structure of incentives and constraints to bear on the independent decision-making units, so as to assure that their general behavior will be consistent with overall policy objectives, while maintaining their freedom of adaptation to detailed environmental conditions.

47. Planning in the above sense requires: (a) the establishment of an orderly pattern of information flow; (b) the analysis of this information, to the end of deriving policy objectives; and (c) the design of an integrated mechanism of policy execution and error correction, consisting of a network of functions and controls for the hierarchical part, and of a pattern of incentives and constraints for the coordination of the part consisting of independent decision-making units.

#### (a) Organizing a Pattern of Information Flow for Planning

48. Information for industrial planning purposes comes from a variety of sources. Basic data on economic conditions and on the operation of the productive system are supplied by the usual statistical efforts. In addition, data are also needed on technological relationships and input-output flows between different productive processes which are not customarily provided by the traditional censuses and sample surveys. In part, they can be obtained from local sources; in part, they may, however, have to be obtained from foreign technical sources, since data are needed on potential new production processes not yet established in the area. A most important category of information originates in the fiscal, regulatory and planning agencies of the government, and in public enterprises: tax returns, foreign trade data, project descriptions submitted with loan or import license applications, data on electric consumption, freight movements, etc.

49. Information is seldom used for planning in the form in which it is gathered. From the point of view of an efficient information system, however, all the original data needed for planning, whatever their source, should be recorded as soon as possible in a code directly acceptable by machines. A key task is the

establishment of a unified system of memory files to which all authorized units of the subsystem have access for purposes of use and updating, in order to avoid the duplication of effort in maintaining and revising the same information in several different places. Most actual organizations furnish numerous examples of such duplications of effort, and the operations of governments abound in them. It is typical that the files of one department are inaccessible to other departments, and the extraction of needed information from a variety of jealously guarded archives poses a major difficulty and constant delay. The systematization and mechanization of keeping such files is indispensable for handling the larger volume of information required by increasing planning efficiency: the information needed increases both in detail and in frequency of revision. This puts a considerable load on all elements of the information system, including the contacts with the original sources.

50. Data can be extracted from the memory files and consolidated in any required manner, rearranged and otherwise processed by punched-card tabulators or electronic computers. Given the volume of data to be handled and the flexibility required in handling, computers are almost certain to be required. This becomes even more of a necessity when some of the files are set up for joint use by the planning subsystem and some other government agencies.

51. Much experience has been accumulated in recent years in regard to the organization and physical embodiment of efficient information gathering, storage and presentation systems. Most of this experience can be brought to bear, without significant revisions, on the design of unified information systems for industrial development planning.

(b) Data Analysis and Policy Formulation

52. It is often affirmed that the data gathered in any of the less developed areas are subject to so much error that they will not support adequately a sophisticated mathematical analysis, such as input-output work, linear programming or simulation. This is indeed a justified observation in many cases, but at the same time, admittedly the only way of checking such data for consistency at all levels is to subject them to the discipline of mathematical analysis. The inconsistencies revealed by such experimentation will permit concentrating the effort of data collection and checking into the trouble spots identified by the analysis. Thus, through a series of trials and revisions, the basic data flow on which the planning process rests will acquire a more and more firm reliability.

53. A variety of analytical approaches are available to the problem of formulating policy models which have been extensively discussed in the economic literature and will not be repeated here. Present high-speed computing techniques permit the solution of very large policy models of the linear programming type. Unstructured models of over a thousand rows and almost any desired number of columns now can be solved by standard procedures, and considerably larger models can likewise be attacked successfully if it is possible to identify some internal structure which will permit the application of decomposition or other shortcut methods. Typically, the models derived from economic situations are highly structured, and this practically guarantees that some feasible approach can be found to the solution of any linear policy model once it has been successfully formulated. In special cases, such as models with large amounts of locational and transport structures, solutions to problems with tens of thousands of rows have actually been obtained.

54. Nonlinear models which arise in planning can be solved also by standard algorithms when the nonlinearities involved correspond to decreasing returns to scale on some process or resource use. The converse case, increasing returns to scale, has posed the most untractable problems until recently. This case is, however, of major importance in some models pertaining to the less developed areas, since it arises in problems embodying minimum economic scales. Lately, these nonconvex problems have become accessible to so-called integer programming, which approaches nonconvexities by means of solutions in terms of integer values of variables. Integer programming models close in on their solutions from the "far" (dual) side, starting with large overshoots and decreasing these step by step until the exact optimum is attained. Experience with the existing algorithms indicates

that they converge rapidly to values near the optimum, but often go through indefinite numbers of iterations from this point on with very little further progress. The early convergence, nevertheless, is seen to create a bound on the far side of the optimum. A sampling of feasible solutions to the problem, all of them on the "near" side of the optimum, can thereafter be used to create the opposite bound; thus, the interval between the two bounds contains the optimum and limits its possible error. Good approximations can be hoped for by this double-barreled strategy in most cases.

55. An entirely different approach to model building is the so-called simulation technique, which has been developed originally for use in connection with production scheduling and other business policy problems. Simulation also relies on the use of high-speed electronic computers. It permits the inclusion in the model of probability distributions, time lags and other realistic but mathematically difficult features which generally preclude an analytic solution. Instead of attempting to obtain such a solution, the simulation model explores the time path of development of the model in full detail, for a selected set of policy variables. Repeated runs with different sets of variables can be used to explore some of the interesting combinations, but simulation models do not have the power of cutting across enormous combinatorial possibilities directly to an optimal solution, like optimizing models do. A combination of the two approaches may offer the best choice in a particular situation.

(c) Design of an Integrated Planning Subsystem

56. Mathematical models for policy formulation in industrial development planning have been available for some time. There is, however, a major gap between the concept of a policy model, on the one hand, and the concept of an integrated planning subsystem, on the other. While a policy model is a mathematical construct, a planning subsystem is a network of organizational entities with definite functions and interrelations. Within this subsystem, policy formulation takes place at various hierarchical levels of regulatory activity, generally on the basis of policy models formulated for this purpose. Policies are then translated into concrete executive actions at each level; for example, at the level of an overall planning office and of ministerial planning organs. The executive actions are in part direct managerial decisions; i.e., pertaining to investments in certain key public projects; in another part, they are indirect, defining a pattern of incentives and constraints for the independent decision-making units to which a large portion of the detailed managerial responsibility within the economy is delegated; e.g., the pattern of certain protective tariff rates. Some actions may have an intermediate character: for example, the authorization of a loan by a government development bank to one of the independent decision-making units. All these actions impinge directly or indirectly on the overall economic system. Subsequently, changes will take place in this system as a whole, in part as a result of these actions, and in part due to exogenous factors. The changes are registered in the form of a new inflow of planning data through the information channels to the planning subsystem. The changes are reflected in a reformulation of the policy models and a revision of policy objectives; they are then translated into a new set of executive actions, repeating the cycle.

57. The above description is meant to illustrate the system character of industrial development planning; the actual interrelations within a planning system are likely to be broken into more levels and stages and, in general, are apt to be quite a bit more complex.

58. The experience available with the design of the simpler systems that have been studied so far indicates that it is possible to define a series of concrete tasks in the description of the existing system structure, such as it is; in the projection of system requirements into the future; in the design of the component parts, functions and channels of information flow of the new system; and in the concrete realization and operational testing of this new system. All these tasks can be organized into checklists and sequences of suggested procedures. The systems designed so far have had to overcome varying degrees of difficulties before

smooth functioning was established. One general experience, however, tends to be of particular significance: the new system often has to cope with shocks and distortions which had not been anticipated during system design. At times, outside conditions and requirements change between the time of system design and final realization; at other times, it turns out that the importance of certain key factors had been underestimated. Such outcomes are sufficiently typical to suggest that they represent a normal condition of system development rather than a failure to follow an orderly procedure in system design. Therefore, when a new system is conceived, it has to be anticipated that some major shocks of an unforeseen nature may occur which will have a profound influence on the entire system between its design and realization. Accordingly, system design has to attempt to allow for the unforeseeable: it has to favor flexible systems over rigid ones, adaptive functions over pre-set ones, and it has to identify and protect by suitable buffers the elements of greatest vulnerability within the system. This principle appears to be fully applicable to the subsystems designed for industrial and general economic development planning.

B. The Role of Computers in Planning: Summary

59 The three aspects of industrial development planning discussed above - information flow, policy formulation, and system design - can in principle all be handled without high-speed information processing equipment. The task will, however, not only be facilitated tremendously if planning functions can be built around such equipment, but the volume of information flow, the sophistication of the models (especially their dynamic aspects) and the complexity of design and operation of flexible, adaptive planning subsystems can be carried incomparably further in the latter case. It is held that the combined effects of this added ease and greater potential complexity promise a fundamental breakthrough in regard to the entire problem of industrial development planning, and thereby constitute a key contribution of the information processing revolution to industrial growth in the less developed areas.

VI. Conclusion

60. Given the advantages discussed in the body of this paper, what proportion of the scarce resources of a country should be allocated to acquiring the new technology? No direct answer is possible at present, beyond the conjecture that a large, numerically controlled engineering fabrication facility, on the one hand, and a computer-based planning subsystem, on the other, are both likely to lead to net savings on account of every one of the three key scarce resources of the less developed areas - namely skills, foreign exchange and capital. This is asserted with the proviso that, first, concrete commitments be preceded by careful, comprehensive preliminary studies, and second, that the respective productive facilities or planning subsystems be staffed in adequate numbers by personnel trained on the job during a considerable period of initial operation.

61. In regard to the key tool employed by the new technology (i.e., the electronic computer with its auxiliary equipment) it should be noted that this machine itself belongs to the class of engineering products in whose production numerical control is now acquiring a major importance. Thus, the production of computers, or at least of significant portions of the complete machines, is a distinct possibility in the less developed areas. It should be admitted at the same time that the technological know-how needed for satisfactory applications, and especially for continued progress in this field, will probably have to be transferred from the industrialized countries for some time to come.

1715 E - Nov.1962 - 1,600

E/CONF.39/D/185
SUMMARY
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

**SUMMARY**

Agenda Item: D.1.3

United States of America

# THE POTENTIAL OF THE COMPUTER AND HIGH-SPEED INFORMATION PROCESSING TECHNIQUES FOR INDUSTRIAL DEVELOPMENT

By Dr. Thomas VIETORISZ,
Research Division,
International Business Machines Corporation,
Yorktown Heights, New York

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# THE POTENTIAL OF THE COMPUTER AND HIGH-SPEED INFORMATION PROCESSING TECHNIQUES FOR INDUSTRIAL DEVELOPMENT

by
Dr. Thomas Vietorisz
Research Division
International Business Machines Corporation
Yorktown Heights, N. Y.

1. Recent advances in high-speed information processing, and their characteristic embodiment, the electronic computer, have two key contributions to offer to the industrial growth of the less developed areas. These are, first, the numerically controlled fabrication of the products of the engineering industries and, second, an integrated approach to the organization of efficient industrial development planning systems in these areas.

2. Numerically controlled fabrication methods promise to enlarge greatly the range of metal transforming and machinery industries that can be operated economically under the conditions prevailing in many of these areas. The principal factors tending to produce this result are: a drastic lowering of the minimum economic scale for individual products; a reduction of the level of operator skills required; a guarantee of uniformly high product quality; and an achievement of these benefits at favorable unit capital inputs. Some of the problems are: the comparatively large scale required for the productive facility as a whole, as distinguished from the scale of production of any one product; new skills required in maintenance, engineering and management; the fact that an integrated, numerically controlled plant represents a genuine technological innovation. It is held that the problems can be overcome by the establishment of suitably large plants, if need be on a regional basis; by on-the-job training of staff during a considerable initial operational period; and by a comprehensive study of the interrelations of all functions within new facilities of the kind proposed. The potential payoff from numerical control is truly momentous from the point of view of the less developed areas. With a domestic industry capable of turning out machinery and equipment at reasonable costs in terms of scarce resources, these areas will no longer find their potential savings dissipated and their growth strangled by foreign-exchange shortages on the one hand and formidable dis-economies of capital-goods production, on the other. The domestic manufacture of a variety of capital goods, consumer durables, agricultural and transportation equipment, in any event, will reduce the pressure on their balance of payments, and will make it easier for them to import the commodities whose production remains uneconomical or unfeasible.

3. The electronic computer and recent advances in the design of complex information processing systems also will permit a concentrated attack on the problem of establishing adequate industrial development planning organizations in the less developed areas. While no systems have been studied so far whose complexity would equal that of an entire economy or of the industrial sector, the problem of designing a planning subsystem within the economic system as a whole permits a powerful simplification. This is due to the fact that a major portion of the detailed management decisions pertaining to industrial production are typically left to

independent decision-making units: private firms or largely autonomous public enterprises. Thus the planning subsystem will have a hierarchical part complemented by a collection of independent decision-making units. Under these conditions, planning reduces to the spelling out of consistent policy objectives and suitable executive action at different hierarchical levels, and to the establishment of a pattern of incentives and constraints for the independent decision-making units to hold the general behavior of these consistent with overall policy objectives, while maintaining their freedom of adaptation to detailed environmental conditions. Planning in this sense requires the establishment of an orderly pattern of information flow, the analysis of data for deriving policy objectives and policy instruments, and the design of an integrated mechanism of policy execution and error correction. In relation to the design of the latter mechanism, recent experience with systems indicates the need for anticipating the occurrence of shocks and disturbances, the exact nature of which is unforeseeable, and consequently puts a premium on flexibility, adaptability and the shielding of the sensitive elements of the system. It is concluded that high-speed computers and related data processing techniques facilitate the organization and performance of the above functions so decisively that they promise a breakthrough in relation to the whole approach to industrial development planning.

4. While no quantitative conclusions are possible with regard to resource allocation to the new technology, it is conjectured that both numerically controlled fabrication and computer-aided industrial development planning will yield net saving of the three scarce resources, skills, foreign exchange and capital. Moreover, the production of computers and auxiliary equipment, or of some of their components and assembly operations, is a distinct possibility in the less developed areas.



S - 1715 E - Nov.1962 - 1 600

E/CONF.39/D/186
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

Agenda Item: D.2.2

Sudan

# LOCATION OF INDUSTRY

By Ginawi Hussein GINAWI,
Assistant Inspector,
Industries Section,
Ministry of Commerce,
Industry and Supply

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

LOCATION OF INDUSTRY.

by Ginawi HUSSEIN GINAWI,
Assistant Inspector, Industries Section,
Ministry of Commerce, Industry & Supply.

Since the introduction of the Approved Enterprises (Concessions) Act in 1956 more than 200 projects have been classified as approved enterprises. Most of them, if not all, are concentrated in the Khartoum area, in Khartoum North and Omdurman. The object behind establishing such industrial areas is to install all service stations, garages, light and heavy industries, and other utilities for supplying that particular town or Province and offering the services required. The Greater Khartoum Area fulfills the requirements of good siting.

The Khartoum light industrial area now holds all garages, service stations, stores and very light industries e.g. beverage industries, packing, cleaning, confectionery, stationery, etc. The area is now fully occipied, but still there is an area to be accommodated for expansion in the coming 25 years. Khartoum industrial area is well sited as far as transportation is concerned. The railway central station lies half a mile east; it is connected by road to Omdurman, and by rail and road to Khartoum North which is the centre of industry in the Sudan and by rail to the port. Generally speaking, it is a centre of rail and road transport to all parts of the country. It is hard to find an ideal site for locating a certain or a number of industries. The largest industrial area is the heavy industries areas of Khartoum North. It is quite suitable from many aspects viz availability of cheap water and electricity, good roads and railway sidings, having a number of related industries in the same vicinity and so on. Its main disadvantage, however, lies in the absolute flatness of the area which makes the disposal of affluents quite a problem, the satisfactory solution of which calls for lots of expenses. Shortly, however, a sewage system will be made and connected to the main system of the town. The concentration of all industries in this area allows it to enjoy most of the privilages necessary for plant

location.

Khartoum North industrial area - Sudan industrial centre - is considerably growing and increasing in size. When considering the establishment of this area, several factors were taken into consideration. The three towns markets is the most active market in the Sudan and the wholesale merchants and the commission agents who supply the provincial markets are in the three towns. Secondly, Khartoum North enjoys a good rail service and factories could easily enjoy a railway siding facility. Apart from being a central place between the port and the markets, Khartoum North also enjoys pure water, well water supply and enough electricity.

Transport, market, proximity to Port Sudan, power, water, supplies and labour have all put Khartoum North area on a very high level as opposed to other sites for industries The most important industries in Khartoum North area are the Sudan-American Textile Industries, the Flour Mills, the Glassworks Factory, the Brewery, the Distilleries, the Chemical Industries, the Soap and Oil Mills. It is difficult, however, to lay down figures for the number of workers per industrial area. This is because different industries vary in their need. Some have their machinery at ground level, so they occupy a large area, while others have multi-story buildings like the flour mills and the distilleries. Factories which are equipped with automatic machines need a small number of workers. On the contrary, industries like the knitwear need many workers in somewhat small area. Realizing that there is a remarkable progress in the industrial field and that there is a great tendency for establishing new industries, four plots have been demarcated for the allotment of the approved enterprises in the next 25 years.

In all cases a flat rate of P.T.23 per square metre is fixed for Khartoum North and P.T. 46 for Omdurman. This rate enclose the premium price of the land plus the essential works charge. In the first case the premium price is P.T.10 per square metre and P.T.13 representing the charges for essential works that would be carried out e.g. road making canals for drainage, and providing all other utilities and services for the area. In the second case the actual price per square metre is P.T.25 and essential works charges is P.T.21 per square metre.

(1 Sterling Pound = about P.T.97)

The rates for special sites outside the Greater Khartoum area are assessed according to the land value of the particular locality. The number of industries located outside Khartoum Province is considerably small, one or two factories may be placed adjacent to a certain town, for example, the cigarette factory in Wad Medani, two match factories will be constructed one in Kosti and the other in El Obeid, a petroleum refinery, fertilizer factory and grain elevator are to be established in Port Sudan and Gedaref. As there are great potentialities of fruits and vegetables in Northern Province a cannery for the processing of both will be located at Karima where there is at present a factory for fumigation, packing of dates and manufacture of alcohol for industrial and pharmaceutical purposes. For the same reason, a factory for drying of milk will be set up in Babanousa (Kordofan Province). Besides a cardboard factory and a dom powder producing factory, for animal fodder, and which have already been built in Kassala Province, a third one for onion dehydration will be erected in the very area where there is abundance of onion.

The industrial areas in the three towns are well organized. Obnoxious industries have been grouped in the remote part of Omdurman industrial area, Khartoum North area is by far the best organized one, and it can be said that the majority of

industries are concentrated in this area.

Grouping or concentration of industries in one particular area will definitely lead to many advantages as well as some disadvantages. Regarding the advantages, it would be of much use to inter-related industries. This is mainly due to the fact that cost of transportation of the by-product or the finished commodities from one factory to the other will be considerably low. Thus factories making use of this fact will economise in transport and time as well. Again, as there is always heavy lorry traffic between factories and the markets as well as among inter-related industries, the aim of grouping, in this respect, is to minimise danger and nuisance that might be caused to the residential areas. It is also evident that public or essential services such as water, electricity, water disposal system will be cheaper for a group of industries than individuals. Public transport for workers will be easily provided. Equally important is the social side. For the welfare of workers, sport facilities, medical services, display centre, clubs for the industrialists to entertain customers should be available. This is only possible in case that all industries are located in one area. On the other hand, the disadvantages of such organization are mainly due to the nuisance caused by noise and smell. With regard to smell, some industries abattoirs, tanning, chemicals, soap and oil industries make this type of nuisance. Dust in wood-working, cement manufacture, cleaning of wheat and sesame may cause some sort of inconvenience to others. Flies and vermins which are likely to be found in the areas of food industry, glue making and tanneries may spread and infect the whole area. Accumulation of raw materials together with some of the finished and waste products that cannot quickly be taken create some untidiness. Fortunately, in the greater Khartoum area most of these problems have been overcome by setting industries that share in these

troubles in separate areas.

The Government is now trying to make use of all raw materials resources in the different parts of the country, especially in the South. This was not possible in the past because some factors stood in the way of the full utilisation of these resources. These factors are:-

1) Distance and lack of easy communication.
2) Lack of Skilled Labour
3) Lack of capital and technical know-how.
4) Lack of cheap power.

Fortunately, with the economic development that took place in the North and the attitude of the Sudan Government towards the development of the South, which contains resources of raw material, which have not been tapped, and its policy towards the industrialization of the whole country, most of these factors are now easier to overcome.

The problem of communication will no longer be a major obstacle to industrial development as the extension of the Sudan Railways system to the South has now reached Wau a fact which puts the Southern Sudan within easy reach.

The difficulty of finding skilled labour and Marketing facilities will be lessened as a result of the increase in technical and vocational training.

Industries that have already been established in the South are: The Textile Industry at Nzara, saw mills, soap factories and oil mills, while in Wau we find only one factory for the manufacture of twines and ropes from sisal, but now a vegetable and fruit canning factory will be set up in Wau too. Investigations carried on papyrus plant have revealed that it is possible to make a paper factory which will meet the country's need at the start and may be able to export the surplus.

Consequently it is hoped that a factory for manufacture of paper from papyrus will be constructed in Malakal.

For the development of industry in other parts of the country, attention has been drawn to the utilization of potential water power at Sennar Dam, Roseires Dam and Khashm El Girba Dam. As for the first it is expected to be operated in November 1962. However, in a few years to come electric power will be quite available and can cater for the increasing demand of the growing industries. Measures taken by the Government in the Seven Years Plan for extension of railway lines, improvement of roads and the establishment of centres and technical schools for training of workers, all these will contribute towards the diffusion of industry in the country.

When deciding the location of a certain industry, however, the aim is usually to select the best locality that would enable the manufacturer to bring raw materials to be processed and delivered to the consumer at the lowest possible cost.

Although this statement shows generally the problem of plant location, yet in many cases the selection of a suitable site for an industry may be influenced by other factors which would not have weight on the cost; thus the function of the planner will generally consist in pointing out and measuring - in terms of money all the particular problems and elements that would have effect on the price of the end product. Many industries, however, have little freedom of choice. An example of this case is quoted by the cane sugar factory which cannot be erected in any place except near the plantation. Transportation of such a huge amount of this material will be costy. To evade such conditions a sugar factory in the Sudan has been erected in Guneid on the Blue Nile about 80 miles south-East Khartoum, in addition, steps have been taken to construct another one at Khashm El Girba. For the same reason, other factories have been

located at Aroma in the Eastern Sudan where there is enough quantity of cotton stalks, which are to be used as raw material to feed the factory.

The Location of an industry, however, plays an important role in minimization of costs. Location not built to plan, that is to say, not economically sited may be handicapped by the severe competition from others. On the other hand, the transfer of a plant from one place to another will greatly affect the major part of the invested capital in making new buildings, the necessary ancilaries and utilities. The efficiency of the machines, too, might be effected due to this transfer. Realizing this, it is, therefore, important from the start to choose the most suitable place so as to avoid all these problems.

Besides the raw material resources, there are other factors which determine the location of an industry. These may be grouped under transport facilities, market, geographic factors, availability of workers, water resources, electricity and other possible factors. Under the heading of raw material comes all the materials needed by the factory and the packing material for the products. The influence and importance of raw material might even determine the location of the factory or could equally be counter-balanced by the effect of another material or factor.

An illustration of such effect could be quoted in case of the Tannery which is located in Khartoum South. Many points had to be taken carefully into consideration. The main limitation was the huge quantity of water needed for treatment of hides and skins and ultimately the disposal of waste water. This problem, however, made Khartoum South the most favourable site for location as opposed to other possible sites.

In the Sudan where you need to transport a commodity very long distances (area of Sudan 1 million square miles) the rate of transport may also influence the siting of any one factory. It is often better from the economical point of view

to place it as near to the raw material area as possible.

In some cases, the market plays an important role in siting any industry and it could be a limiting factor in plant location. However, the advantages and disadvantages of all the possible sites should first of all be checked and a thorough study should be made before the final commitment.

To sum up, plant location is considered one of the most important factors determining the success of an industry. By choosing and planning the best locality on an economical basis, one could be sure of the smooth running of a factory. This is, of course, so long as other factors are favourable.

1722 E - Nov.1962 - 1,600

E/CONF.39/D/186
SUMMARY
12 Nov.1962
ORIGINAL : ENGLISH

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

**SUMMARY**

Agenda Item: D.2.2

Sudan

# LOCATION OF INDUSTRY

By Ginawi Hussein GINAWI,
Assistant Inspector,
Industries Section,
Ministry of Commerce,
Industry and Supply

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# Location of Industry

by Ginawi Hussein Ginawi,
Assistant Inspector, Industries Section,
Ministry of Commerce, Industry & Supply

Since the introduction of the Approved Enterprises (Concessions) Act in 1956 more than 200 projects have been classified as approved enterprises. Most of these are concentrated in the Greater Khartoum Area. The largest industrial area is the heavy industries area of Khartoum North. It is quite suitable from many aspects viz availability of cheap water and electricity, good roads and railway sidings. Its main disadvantage, however, lies in the absolute flatness of the area which makes the disposal of affluents quite a problem, the satisfactory solution of which calls for lots of expenses. Shortly, however, a sewage system will be made and connected to the main system of the town. Khartoum North area is by far the best organized one and it can be said that the majority of industries is concentrated in this area. The number of industries located outside Khartoum Province is considerably small.

The Government is now trying to make use of all raw material resources in the different parts of the country, especially in the South. This was not possible in the past because some factors stood in the way of full utilisation of these resources. These factors are :-

1) Distance and lack of easy communication

2) Lack of skilled labour

3) Lack of capital and technical know-how

4) Lack of cheap power

Fortunately, with the economic development that took place in the North and the attitute of Sudan Government towards the development of the South, which contains resources of raw material, that have not been tapped, and its policy towards the industrialisation of the whole country, most of these factors are now easier to overcome.

The problem of communication will no longer be a major obstacle to industrial development as the extension of Sudan Railways system to the South has now reached Wau a fact which puts the Southern Sudan within easy reach.

The difficulty of finding skilled labour will be lessened as a result of the increase in technical and vocational training.

For the development of industries in other parts of the country, attention has been drawn to the utilisation of potential water power at Sennar Dam. Roseires Dam and Khashm El Girba Dam. As for the first, it is expected to be operated in November of this year.

However, in a few years to come electric power will be quite available and can cater for the increasing demand of the growing industries. Measures taken by the Government in the Seven Years Plan for extension of railway lines, improvement of roads and the establishment of centres and technical schools for training of workers, all these will contribute towards the diffusion of industry in the country.

To sum up, plant location is considered one of the most important factors determining the success of an industry. By choosing and planning the best locality on an economical basis, one could be sure of the smooth running of a factory. This is of course, as long as other factors are favourable.



S - 1722 E - Nov.1962 - 1,600

E/CONF.39/D/187
13 Nov.1962
ORIGINAL : RUSSIAN

КОНФЕРЕНЦИЯ ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ
ПО ВОПРОСУ О ПРИМЕНЕНИИ НАУЧНЫХ И ТЕХНИЧЕСКИХ ЗНАНИЙ
ДЛЯ УДОВЛЕТВОРЕНИЯ ПОТРЕБНОСТЕЙ МЕНЕЕ РАЗВИТЫХ РАЙОНОВ

ПУНКТ ПОВЕСТКИ ДНЯ: D.2.2

СССР

# ОСОБЕННОСТИ РАЗМЕЩЕНИЯ ПРОМЫШЛЕННОСТИ В МАЛООБЖИТЫХ СТРАНАХ

Составил А. Д. ДАНИЛОВ,
доцент, заведующий кафедрой
экономической географии
Московского института народного хозяйства
им. Г. В. Плеханова,
действительный член Географического общества
СССР

Документы, составленные для Конференции Организации Объединенных Наций по вопросу о применении научных и технических знаний для удовлетворения потребностей менее развитых районов, служат в качестве рабочих документов для этой Конференции. Они опубликованы в том виде, в каком были представлены их составителями, и их содержимое и выраженные в них мнения принадлежат их составителям (см. примечания на оборотной стороне).

## ПРИМЕЧАНИЯ

1. Документы, включенные в число материалов, принятых для обсуждения на общих сессиях, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

2. Документы, включенные в число материалов, принятых для обсуждения на специализированных сессиях, будут в распоряжении делегатов Конференции только на одном из этих официальных языков.

3. Резюме всех документов в том виде, в каком они были представлены их составителями, будут в распоряжении делегатов Конференции на следующих официальных языках Организации Объединенных Наций: русском, английском, испанском и французском.

4. До открытия Конференции документы и резюме не будут выпущены для общего распространения. Они будут опубликованы заблаговременно только в ограниченном числе экземпляров и исключительно для правительственных делегаций и других правомочных участников. Последующие опубликование и рассылка трудов Конференции будут обеспечены в соответствии с практикой Организации Объединенных Наций, как это установлено ее Издательским комитетом.

# ОСОБЕННОСТИ РАЗМЕЩЕНИЯ ПРОМЫШЛЕННОСТИ В МАЛООБЖИТЫХ СТРАНАХ

А.Д. Данилов, доцент, заведующий кафедрой экономической географии Московского института народного хозяйства им. Г.В.Плеханова, действительный член Географического общества СССР

Населенность территории составляет первую необходимую предпосылку промышленного и всякого другого хозяйственного ее освоения. Трудящееся население - главная производительная сила общества.

К числу важнейших предпосылок промышленного развития стран и районов относится наличие в них определенного разнообразия и достаточных запасов природного или сельскохозяйственного сырья. Чем богаче страна запасами промышленного сырья, тем благоприятнее в ней условия для промышленного развития.

Однако, эти предпосылки не являются единственными и решающими. В современном мире множество малых и даже крупных стран, располагающих огромными ресурсами сырья, большой численностью и высокой плотностью населения, остается в промышленном отношении чрезвычайно слабо развитыми. К таким странам относятся, например, большие и малые страны на азиатском, африканском и южно-американском континентах. В то же время такие страны как Нидерланды и Бельгия, бедные природными ресурсами, являются высокоразвитыми индустриальными странами мира. Канада и Австралия, как высокоразвитые промышленные страны - с одной стороны, и Индонезия и Бирма, как отсталые в промышленном отношении страны - с другой стороны, - вот разительный пример того , что ни природные богатства, ни различная численность и плотность населения не являлись главными движущими силами определяющими различия их уровня промышленного развития.

Эти различия создавались капитализмом. Нидерланды, Бельгия, Канада и Австралия, в силу сложившегося хода мировой истории имели огромные доходы от колониальных владений и войн. Индонезия, Бирма и другие бывшие и современные колониальные страны, - это государства и территории, где до недавнего времени господствовали иностранцы и где сильны феодальные и даже родовые отношения; в силу хода мировой истории они оказались в колониальной кабале у более развитых в экономическом отношении капиталистических стран.

Капиталистический способ производства является более передовым в отношении более ранних социальных систем, с точки зрения развития производительных сил и роста промышленности. Но капитализм с его частной собственностью на средства производства, с эксплуатацией человека человеком, с его погоней за наживой и с конкуренцией неразрывно связан с угнетением и эксплуатацией малоразвитых стран. При капитализме, даже освобождающиеся от колониального рабства страны остаются сырьевыми придатками более развитых капиталистических государств. Свидетельством этого служат многие страны, например, Южной Америки, освободившиеся от прямой колониальной зависимости, ставшие на капиталистический путь развития, но

остающиеся и поныне сырьевыми аграрными странами современного капиталистического мира.

В Советском Союзе складывались иные взаимоотношения между промышленно развитыми и экономически отсталыми ра"онами. Основной линией экономического развития ранее отсталых аграрных ра"онов было развитие местной промышленности, широкая программа народнохозя"ственных и социальных преобразований на базе индустриализации.

Наглядным примером могут служить Казахстан и республики Средней Азии. До 1917 г. Казахстан был страной кочевого скотоводства - овцеводства, которое давало 70% производимого здесь валового продукта. В Средней Азии господствовала монокультура хлопчатника, хлопководство давало здесь до 90% всего валового продукта. Городское население было ничтожно и составляло в Казахстане 6%, в Средней Азии - 10% всего населения.

Возникшая после Октябрьской революции в России Казахская советская социалистическая республика ныне стала не только индустриальной, но и разносторонней в экономическом отношении. Промышленность дает до 60% валового продукта республики, городское население составляет почти половину всего ее населения. Республика занимает первое место в СССР по выплавке свинца, меди, цинка и ряду других цветных металлов, является одним из важных ра"онов по добыче угля и производству кокса, по выплавке чугуна и стали, мясной, кожевенной, плодоконсервной, сахарной и ряда других отраслей пищевой и легкой промышленности. При этом за советские годы поголовье овец здесь увеличилось на 60%, вся посевная площадь - в 7 раз. Казахстан ныне не только сохранил свое важное значение в животноводстве, но стал крупнейшим производителем зерна, главным образом пшеницы /после освоения его целинных земель/. Казахстан стал высокоиндустриальной республикой, с развитым животноводством и земледелием.

На территории Средней Азии в пореволюционное время образованы Узбекская, Киргизская, Таджикская и Туркменская советские социалистические республики, входящие непосредственно в СССР и Кара-Калпакская автономная советская социалистическая республика, входящая в Узбекскую ССР. Промышленность в этих республиках дает от 2/3 до 3/4 их валового продукта, городское население составляет свыше 35%. За советские годы валовой сбор хлопка-сырца в них увеличился почти в 6 раз, создана крупная хлопкоочистительная, маслобойная, хлопчатобумажная, шелковая промышленность, большое развитие получили сельскохозяйственное машиностроение, пищевая, нефтяная, газовая, химическая, цветных и черных металлов и ряд других отраслей промышленности. Советские республики Средней Азии стали индустриально-аграрными с разносторонним развитием в них промышленности и сельского хозяйства.

Казахстан и Средняя Азия занимают довольно обширную территорию, - 4 млн. кв. км. с общей численностью населения в 1961 году - 25 млн. человек. Динамика заселенности и состава населения по отдельным республикам представляется в следующем виде:

| Название республики | Площадь тыс. кв.км | Население тыс. человек | | Число жителей на 1 кв.км | | Городское население в % | |
|---|---|---|---|---|---|---|---|
| | | 1926г. | 1961 г. | 1926г. | 1961г. | 1926г. | 1961г. |
| Казахская ССР | 2756 | 6170 | 10387 | 2.2 | 3.8 | 8 | 44 |
| Киргизская ССР | 199 | 995 | 2225 | 5.0 | 11.2 | 12 | 35 |
| Узбекская ССР | 409 | 4543 | 3665 | 11.1 | 21.2 | 22 | 35 |
| Таджикская ССР | 143 | 1034 | 2104 | 7.2 | 14.7 | 10 | 34 |
| Туркменская ССР | 488 | 1001 | 1626 | 2.0 | 3.3 | 14 | 47 |
| Итого | 3995 | 13743 | 25007 | 3.4 | 6.3 | 14 | 40 |

За последние 35 лет по всем республикам значительно возросло общее количество и особенно сильно увеличился удельный вес городского населения. Эти процессы тесно связаны друг с другом. Индустриализация, а затем коллективизация резко повысили материальный уровень жизни населения: по всем республикам за все эти годы отмечался высокий естественный прирост численности населения. Кроме того, в связи с быстрыми темпами и огромными масштабами промышленного строительства сюда переселялось довольно значительное количество рабочих и специалистов из других республик СССР, больше всего в горную промышленность Казахстана и Киргизии, а также на освоение целинных земель /Казахстана/.

По всей Средней Азии и Казахстану на 1 января 1961 года значилось 452 города и поселков городского типа, почти 9/10 из них возникли за советские годы. Особенностью расселения городского населения, отражающим особенности размещения промышленности, является довольно значительная его концентрация в сравнительно крупных центрах. В городах с населением от 50 до 500 тыс. человек /40 городов/ здесь проживает почти половина всего городского населения. В целом по СССР в городах такого типа проживает немногим более трети всего городского населения страны.

Существенно, что такая концентрация городского населения характерна и для ряда других районов нового промышленного освоения в СССР. Так если в старом углепромышленном районе страны в Донецкой области Украины в среднем на одно городское поселение приходится 22 тыс. человек, в Кузбассе - Кемеровской области - 37 тыс. человек, в Карагандинской области Казахстана - 32 тыс. человек.

Второй особенностью размещения промышленности в малообжитых районах является очаговый характер ее размещения. Это очень хорошо выражено на прилагаемой картограмме новых городских поселений Казахстана и Средней Азии /см. приложение/. Самый большой сгусток городских поселений образовался вокруг Ташкента и в Ферганской долине, с очень разнообразными промышленными предприятиями: машиностроения, текстильной и пищевой, нефтяной и газовой промышленности, цветной и черной металлургии, химической, горно-рудной промышленности и электроэнергетики. Крупные очаги преимущественно машиностроения, легкой и пищевой промышленности, оразовались вокруг столичных центров всех республик, за исключением Туркмении, где индустриальное развитие тормозилось ограниченностью водных ресурсов /в 1962 году сюда подведен Каракумский канал, что отчасти

широкие возможности промышленного роста Ашхабада и прилегающего к нему района/.

Крупный очаг промышленности с многочисленными поселениями городского типа образовался вокруг Караганды, с ведущей ролью угольной, металлургической, химической и пищевой промышленности. Большой промышленный очаг создан на востоке Казахстана, на базе освоения горнорудных богатств Алтая, с ведущей ролью цветной металлургии и гидроэнергетики. На базе цветной металлургии развиваются очаги Текели, на юго-востоке Казахстана, Приаралхашский и Джезказганский - в центральном Казахстане. Растут очаги тяжелой индустрии вокруг Кустаная на базе его железорудных и угольных богатств, в районе Актюбинска - южный Урал, - на базе развития здесь химических производств и качественной металлургии, в районе Эмба-Гурьев - на базе развития нефтяной промышленности. Такого же профиля с ведущей ролью нефтяной и химической промышленности развивается очаг на западе Туркмении, - Красноводск - Челекен-Небит-Даг-залив Кара-Богаз-Гол. В текущей семилетке закладываются новые промышленные очаги: на базе вновь открытых нефтяных и газовых богатств полуострова Мангышлака, в районе Бухары - на уникальных по масштабам запасах природного газа, на Вахше в Таджикистане на базе строящейся здесь крупнейшей в Средней Азии Нурекской ГЭС; обширный с разносторонней промышленностью - Павлодарско-Экибастузский очаг, где осваиваются открытыми карьерами угли Экибастуза, строится одна из крупнейших в стране тепловая Ермаковская ГРЭС, сооружаются глиноземный и аллюминиевый заводы, ферросплавов, машиностроительный, пищевые и другие предприятия и т.д.

Определенная концентрация в сравнительно крупных центрах и очаговый характер размещения промышленности в малообжитых районах имеет ряд важных преимуществ: представляется возможным строить более крупные предприятия, что как правило, экономически более выгодно, чем строительство и эксплуатация мелких и разрозненных предприятий, сокращаются расходы на многие вспомогательные устройства, в частности на подъездные пути - транспорт, водоснабжение и т.п.; облегчается комбинирование производств, обеспечивается наиболее полное использование сырья, создаются возможности лучшей взаимопомощи предприятий; улучшаются материальные и духовные условия жизни рабочих. Как правило во всех крупных городах построены многоэтажные жилые дома, клубы, школы, в том числе технические, больницы, столовые, водопровод, канализация, электричество, городской транспорт, и т.д. Такой характер размещения промышленности выгоден для государства и населения.

Широкий размах индустриализации Казахстана и Средней Азии, складывающаяся специфика размещения промышленности в них, не есть результат их стихийного экономического развития. Это есть результат планового научно обоснованного и целеустремленного развития, огромной помощи русского, украинского и других народов, составляющих Союз советских социалистических республик, братского сотрудничества всех народов СССР.

Темпы роста промышленности в Казахстане и Средней Азии за советские годы были более высокими, чем в среднем по СССР. Сюда вкладывались из общесоюзного бюджета крупные средства на новое промышленное строительство, оказывалась большая помощь в оснащении новых строек передовой техникой, опытными рабочими и техническими кадрами, прокладывались новые железные и автомобильные дороги и оросительные каналы, строились крупные гидравлические и тепловые электростанции и т.д. В текущую семилетку, 1958-1965 годы валовую продукцию всей промышленности в Казахстане и Туркмении намечается увеличить в 3 раза, в остальных среднеазиатских республиках более, чем в 2 раза, при намечаемом росте всей промышленности СССР за эти годы на 80%. Эти плановые предположения

перевыполняются.

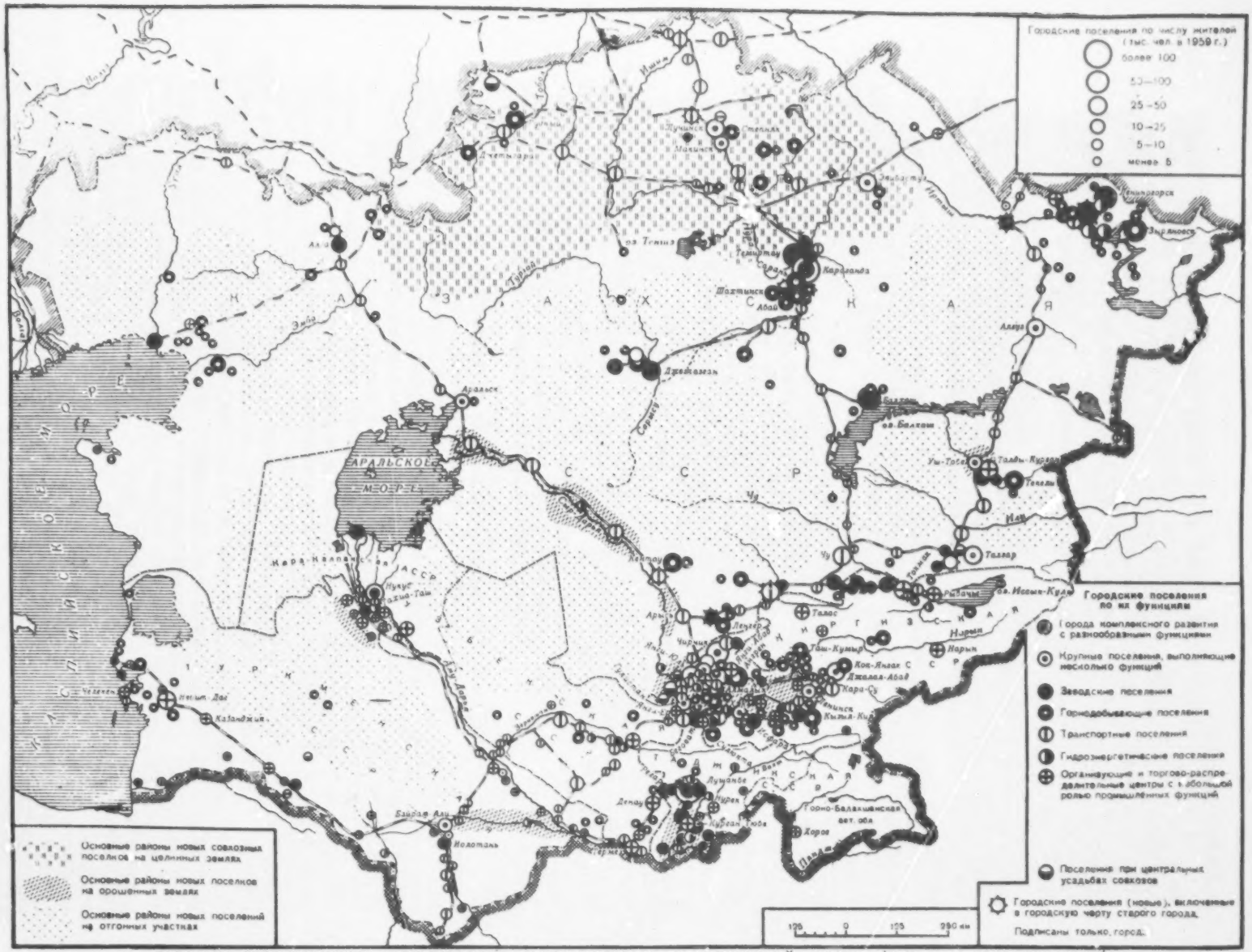
В этих республиках, как и по всему Советскому Союзу, земля и ее недра, воды, вся промышленность и транспорт национализированы, принадлежат государству. Все промышленные предприятия /за исключением колхозных/, находящиеся на территории этих республик управляются местными государственными органами - республиканскими Советами народного хозяйства и другими организациями местных государственных учреждений, с широким участием общественных организаций.

Следует особо отметить огромную значимость изучения недровых ресурсов и других научных исследований проводимых за советские годы в районах нового промышленного освоения, а также мероприятий по повышению культурно-технического уровня местного населения.

В дореволюционное время при одностороннем скотоводческом развитии Казахстана и хлопководческом - Средней Азии, интерес к недровым их богатствам был ограниченным. Сплошная геологическая съемка местности была осуществлена только в советское время. Она проводилась как союзными научными учреждениями, так и местными. Во всех республиках ныне созданы национальные академии наук, университеты, технические исследовательские и высшие учебные институты. На одну тысячу жителей здесь по отдельным республикам приходится 10-13 человек с высшим образованием, 214-256 человек со средним и неполным средним образованием.

За советские годы открыты высокие по качеству месторождения угля в Караганде /в том числе коксующегося/, в Экибастузе /доступные для открытой разработки/ и других местах; уникальные по запасам месторождения природного газа в районе Бухары и нефти на Мангышлаке; колоссальные запасы фосфоритов в Каратау; многочисленные и крупные месторождения железа, меди и апатитов в центральном и северном Казахстане, серы и нефти в Туркмении, полиметаллических руд на Алтае, в Заилийском алатау, в горах и предгорьях Тянь-Шаня и Памира и др. Эти открытия и промышленная их разведка служили естественной основой развития разнообразных отраслей горнодобывающей промышленности.

Важную роль в правильном размещении промышленности в малообжитых районах страны занимают, только в Советском Союзе, осуществляемые, комплексные научные экономико-географические исследования, так называемые "районные планировки" местности, широко проводимые организациями Гипрогора /Государственные институты по проектированию городов/ и другими проектными и научными учреждениями. В эти исследования включается очень широкий круг специалистов: картографы и землеустроители, геологи и геоморфологи, климатологи и гидрологи, инженеры и экономисты различных специальностей, архитекторы, коммунальники, транспортники и др. На основании изучения прежних различных исследований по данной местности, визуальных наблюдений на месте, ряда рекогносцировочных исследований, обширных технико-экономических расчетов и т.д. вырабатывается предварительная рабочая гипотеза будущего промышленного освоения определенной территории, размером от нескольких сот до нескольких тысяч кв. км. Эти рабочие гипотезы затем поступают в плановые государственные органы, которые по ним, в последующем, принимают решения о направлении дальнейшего экономического развития определенных районов, а затем дают задания специализированным проектным организациям для проектирования соответствующих промышленных или транспортных объектов. Размещение промышленности в малообжитых районах проводится по строго продуманному научному плану.




НОВЫЕ ГОРОДСКИЕ ПОСЕЛЕНИЯ КАЗАХСТАНА И СРЕДНЕЙ АЗИИ /ПО НАЗАРЕВСКОМУ/



473 R - Nov.1962 - 600

E/CONF.39/D/187
SUMMARY
15 Feb.1963
ENGLISH
ORIGINAL : RUSSIAN

UNITED NATIONS CONFERENCE
ON THE APPLICATION OF SCIENCE AND TECHNOLOGY
FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

**SUMMARY**

Agenda Item: D.2.2

USSR

# SOME FEATURES OF INDUSTRIAL GEOGRAPHY IN NEW INHABITED LANDS

By A. DANILOV,
Lecturer, Head of Department
of Economic Geography of the "G.V. Plekhanov"
Institute of National Economy, Moscow,
Member of the Geographical Society of the USSR

Papers have been contributed to the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas as working papers for that Conference. They are published as presented by the contributors, and the contents and the views expressed are those of the contributors. (See notes overleaf.)

## NOTES

1. Papers selected for inclusion in General Sessions will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

2. Papers selected for inclusion in Specialized Sessions will be available at the Conference in only one of the above official languages.

3. Summaries of all papers, as submitted by contributors, will be available at the Conference in the following official languages of the United Nations: English, French, Russian and Spanish.

4. Papers and summaries will not be available for general distribution in advance of the Conference. They will be published in advance in limited quantities only for the use of delegations of participating governments and of other authorized participants. Post-Conference publication and general distribution of the Conference Proceedings will follow United Nations practices as laid down by the United Nations Publications Board.

# SOME FEATURES OF INDUSTRIAL GEOGRAPHY IN NEW-INHABITED LANDS

by

A. Danilov

## S U M M A R Y

The report deals with the prerequisites and experience of industrialization, as well as with the distinguishing features of industry distribution in sparsely populated areas of the USSR, taking as an example the development of the Soviet Socialist Republics of Central Asia and Kazakhstan.

The most important prerequisites of industrial development are the density of population in the area and the availability of industrial raw materials of natural or agricultural origin. But these prerequisites are not decisive ones. Nowadays a great number of small and even large countries, which have enormous and varied resources of raw materials, and a dense population, remain at an extremely low level of industrial development. On the other hand, many countries become industrially developed, though their population is small and natural raw materials are limited. Social and historical conditions, under which different countries develop, are of decisive importance for the industrial development of countries including sparsely populated countries.

A convincing illustration of this theoretical thesis is the experience of economic construction in the Soviet Socialist Republics of Central Asia and in Kazakhstan which are part of the USSR.

Before the Great October Socialist revolution cotton single-crop agriculture prevailed in the republics of Central Asia, and nomadic cattle-breeding in the Kazakh SSR. During the years of Soviet rule the economy of the republics was reorganized. After the victory and consolidation of Socialism, the Kazakh, Kirghiz, Uzbek, Tajik and Turkmen Union Republics, working in cooperation and with the fraternal help of other peoples of the USSR became highly industrialized areas with diverse industry and agriculture.

Much attention is paid in the report to the demonstration and analysis of the distinguishing features industry distribution and to preparatory methods of scientific research.

Two characteristic features of industry distribution in sparsely populated areas are shown.

Firstly, rather considerable concentration of industry in relatively large centres. Corresponding concentration of urban population testifies to the fact. In these places about one half of the total urban population lives in towns with a population of 50-500,000, whereas in the USSR as a whole only a little more then 1/3 of the urban population lives in towns of such a type. In similar areas of the old Donets basin an average of 22,000 people reside in urban settlements, in Kuzbass 37,000 people and in the Karaganda basin 32,000 people.

Secondly, industry is centred in nidi, groups of enterprises, which can be clearly seen from the cartogram of "New Urban Settlements of Kazakhstan and Central Asia" attached to the report.

A certain concentration of industry in relatively big centres and the nidular nature of its distribution in sparsely populated areas have a number of important economic and social advantages.

The report shows the practical measures that promoted the accelerated tempo of industrialization of Kazakhstan and the Central-Asian republics, their great achievements in the raising of cultural and technical standards of the population, in the development of mineral resources discovered during the years of Soviet rule in their territory.

An important rôle in the sound distribution of industry, especially in sparsely populated areas, has been played by methods of scientific research. A new method employed in our country consists in integrated economic and geographic research called "regional planning" of the area, which is carried on extensively by the agencies of the State Institute for City Planning and other scientific and designing establishments. A very broad circle of specialists participates in this research. Regional planning provides initial material for the State planning bodies to determine the direction of further economic development of individual areas as well as assigning the design of new construction projects to specialized designing establishments. The distribution of industry in sparsely populated areas is carried on according to a thoroughly elaborated scientific plan.

The report is accompanied by a map of "New Industrial Settlements of Kazakhstan and Central Asia".



S - 473 E - Feb.1963 - 1,600